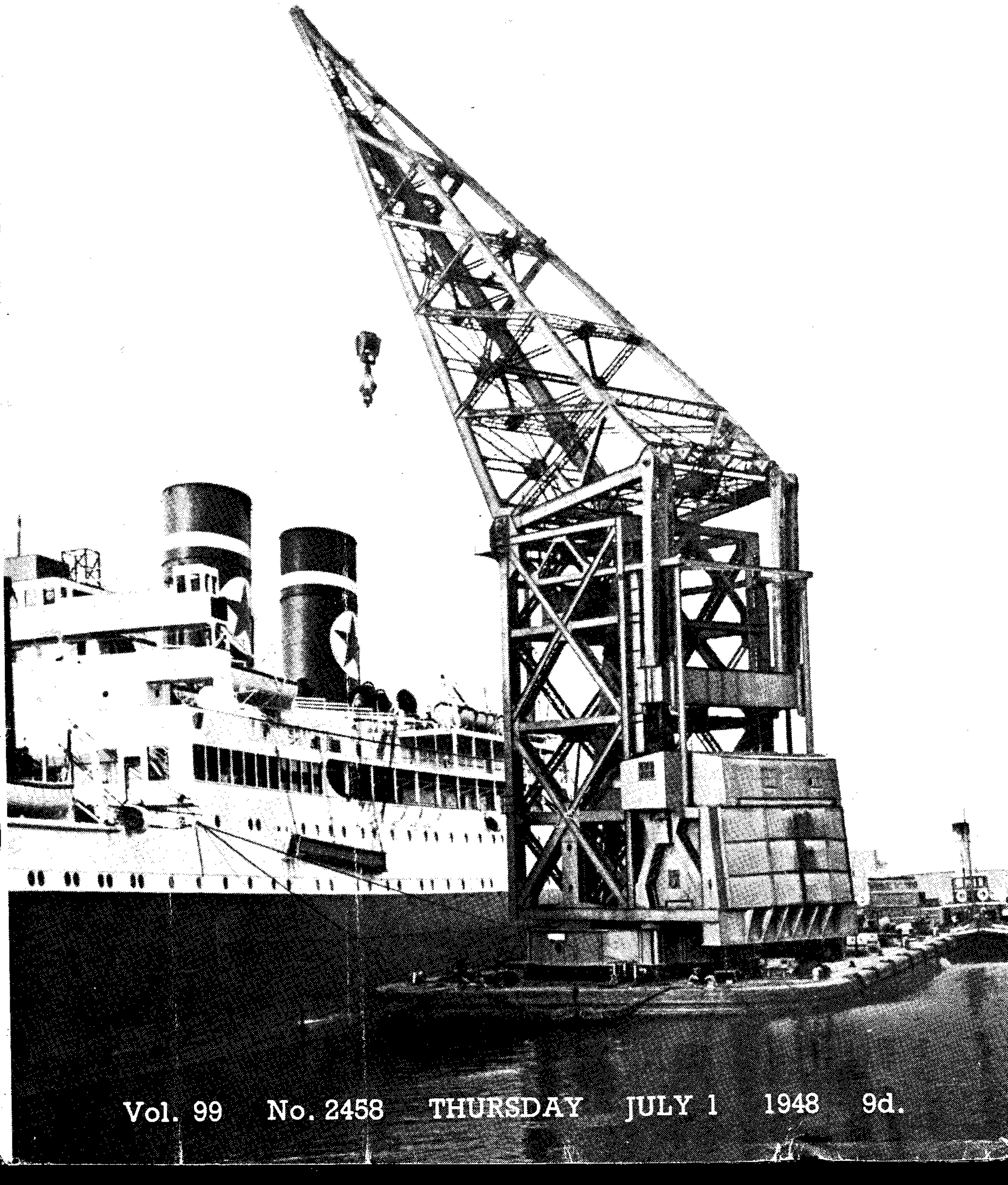
THE MODEL ENGINEER



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The MODEL ENGINEER

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1ST JULY 1948

VOL. 99. NO. 2458

SMOKE RINGS

Our Cover Picture

● THIS WEEK we illustrate one of the mammoth floating cranes in use in the London Docks. The size and area of the pontoon gives one some idea of the loads which can be handled by this crane. The tilting of the pontoon is evidently due to the balance weight, which may be seen on the lower right of the crane tower, and would disappear or might even be reversed when the crane is lifting its maximum load. The turntable is clearly visible, as are also the links and piston-rods from the hydraulic rams which control the tilting of the jib. I don't remember ever seeing a model of one of these cranes, but it seems to me that such a model would provide many interesting problems and would prove rather fascinating in operation.—E.B.

Five Five-guinea Prizes

● I AM now able to tell you that the five five-guinea prizes announced last week to be given in the Competition Section at "The Model Engineer" Exhibition will be awarded as follows :—

THE MODEL ENGINEER prize for the best piece of workshop equipment, with a preference for lathe accessories.

The Model Railway News first, second and third prizes for the best model railway item of the pre-grouping era.

Model Aircraft prize for the best control-line model.

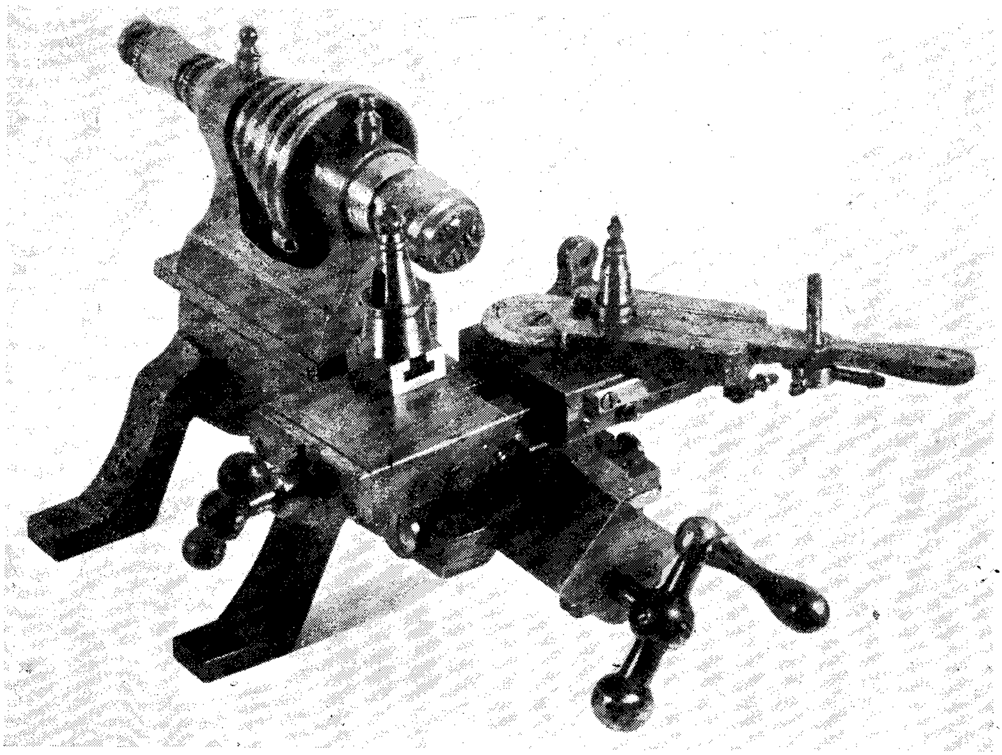
Model Ships and Power Boats prize for the best workmanship in a hull, or a set of ship's fittings on any ship or power boat in the Competition Section.

The Model Car News prize for the best solid scale model made from plans published in *The Model Car News*, or the best original chassis design.—P.D.

The Stroudley Livery

● AMONG THE correspondence resulting from the publication of a "Smoke Ring" on this subject in our issue of June 3rd is a letter from one who should be in a position to give authentic details—none other than our distinguished contributor "L.B.S.C." He writes :—"As my close personal acquaintance with L.B. & S.C.R. engines dates from 1890, I can clear up the mystery of the correct colour of the main frames. *Boxhill* is correct, and Mr. Maskelyne's engine is wrong. The Stroudley engines had their main frames painted black outside, and red inside, with red guard-irons. I cleaned enough of them, goodness only knows (for 2s. 2d. per day !) to recollect them well enough. The error probably arose through 'shed terminology.' The running-boards were always called 'gangways,' the valances 'framing,' and the outsides of the main frames were always referred to by the cleaner boys as 'the blacking-up behind the wheels.' They obviously wouldn't have called it '*blacking-*

up' if it had been red! Had you asked cleaner, fireman or driver what colour the frame was, he would naturally have thought that you were referring to what is today called the valance, that is, the edging underneath the running-board or side platform, and would have replied 'crimson' or 'maroon.' I never saw a Stroudley engine with maroon main frames, and don't know of anybody who ever did. Why the error persisted, is one of those things that nobody seems able to explain. For instance, I have here at the present minute, a coloured postcard of 584 *Lordington*, 0-6-2 tank of Bob Billinton's design. This shows maroon main frames, yet I saw this engine new, the day after she left the works in 1903, and unless I was temporarily colour-blind on that day, the main frames were black outside. Another possible cause of confusion was that Stroudley's first lot of 2-4-0 double-framed engines, and his Craven double-framed rebuilds, had the *outside* frames painted the maroon colour. I well remember this on *Belgravia*, *Westminster*, etc. The first lot of D2 0-4-2 mixed-traffic engines, *Lyons*, *Caen*, *Turin*, etc., had old tenders with outside frames, of Craven pattern, and these were also painted maroon."—P.D.



An Interesting Watch Lathe

● A FRIEND of mine recently unearthed a rather unusual type of watchmaker's lathe, the origin of which is unknown, and I am reproducing a photograph of it here in the hope that some reader may be able to recognise it or give some information on the particular features of its design. As will be seen, the headstock is of fairly normal pattern, and the bed is of prismatic section, but much shorter than usual, so that no tailstock could be fitted in the available space.

An unusual feature in watch lathes is the provision of a sliding saddle, operated by a lead screw running underneath the bed for its full length. Two cross slides are fitted, with independent feed screws at the front and rear respectively. A lantern-type tool post is fitted to the front slide, but the rear slide has its tool post mounted on a swivelling fitting, which appears to be capable of functioning as a spherical turning slide.

No provision is made in the headstock mandrel to take collets of the usual type, but a draw-in spindle is fitted to operate the special chuck screwed on the mandrel nose. This is equipped with a centre locating spigot, and three hooks or dogs which are pulled back towards the chuck face when the draw-in spindle is screwed up. It appears that the lathe was specially built or adapted for some specific purpose in watch manufacture, entailing the chucking of a three-spoked wheel, and possibly the crowning or spherical turning of the rim. The only wheel in a watch to which such operations might apply seems to be the balance wheel, but even so, there cannot have been very many watches fitted with a balance wheel of this type, and it is possible that this fact may help in identifying the lathe or the nature of the operation which it performs.—E.T.W.

A Slotting Attachment for the Lathe

by "Ned"

SLOTTING operations involving the use of a reciprocating tool are not very extensively employed in engineering manufacture, having been largely superseded by broaching in cases where quantity production is concerned. The old type of slotting machine was a comparatively expensive and cumbersome machine, rather out of proportion to its capacity for rapid production. Nevertheless, the type of operation which it performs is extremely useful, and sometimes even necessary, in general engineering workshop practice, and particularly in the tool room. In many cases where a slotting machine is not available, the operation is performed with the aid of a slotting attachment on a milling machine. Many of the operations dealt with by slotting machines, or attachments, are of a nature which are almost, or completely, impossible by other forms of cutting tools, such as, for instance, the cutting of internal keyways and splines, and certain types of internal gears, or squared and polygonal sockets.

In the model engineering workshop where neither a slotting machine nor a milling machine is available, the use of a slotting attachment in the lathe will often fill a very urgent need. The particular principle employed in the attachment illustrated is not claimed to be original; as a matter of fact, this attachment was based on one described by Mr. Ian Bradley in the "M.E." dated July 3rd, 1941, in connection with the machining of a set of hornblocks for the locomotive "1831," which operation was performed with the hornblocks fitted to the frames. The ability to perform an operation of this nature with a simple lathe attachment will undoubtedly appeal to very many readers, and although the rate at which an attachment of this nature can remove metal is limited, this will not seriously affect its usefulness from the model engineer's point of view.

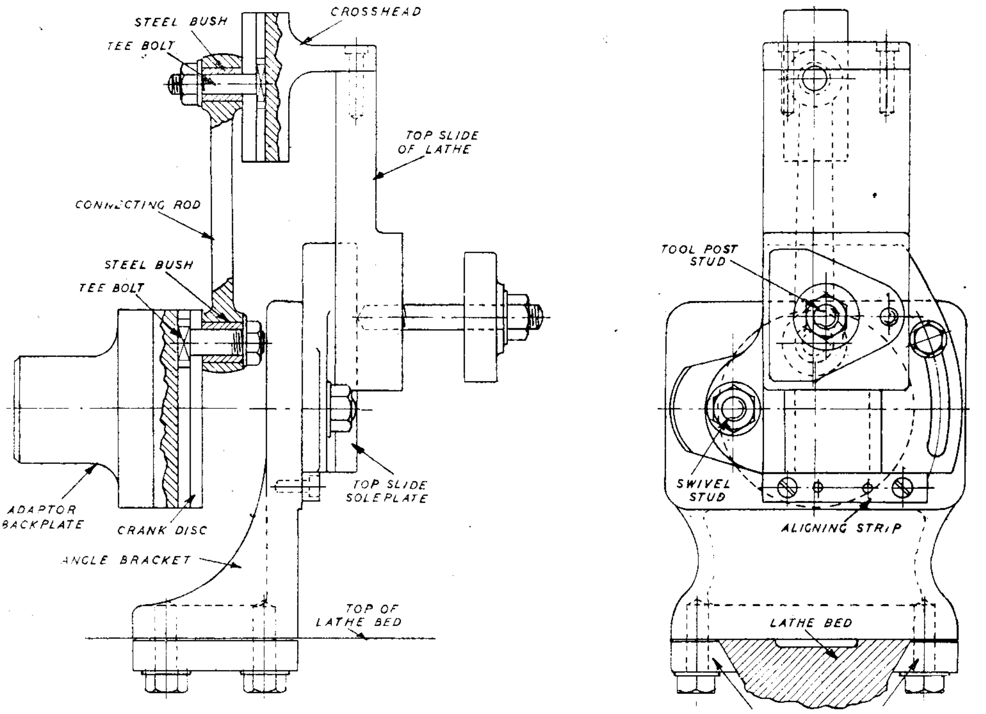


Fig. 1. Side and end elevations of slotting attachment

The attachment devised by Mr. Bradley was fabricated mostly from available pieces of stock material, but in the device illustrated in Fig. 1, castings are used, and will promote rigidity and also, to some extent, adaptability of the device though some, or possibly all, of the parts could be fabricated if desired. It will be seen that the sliding member of the attachment consists of the swivelling top slide of the lathe mounted on a substantial

vertical fixture, and reciprocated by means of a crank and connecting-rod operated from the lathe mandrel. Adjustment of both the length of cutting stroke, and also the position of the tool at the end of the stroke, is provided, and the reach of the cutting tool beyond the foot of the vertical fixture, although somewhat limited if the tool is fixed in the tool post in the normal way, could readily be increased by modifying the form of tool holder employed. The tools used are, of course, the normal type of slotting tools, but their exact form will depend on the nature of the work being handled. For operations such as cutting keyways, the slotting tool employed is very similar to an ordinary parting tool, the side and back clearance being of the same order as in the latter, but the functions of top rake and front clearance are interchanged; that is to say, what would be "front clearance" in a parting tool becomes "top rake" in a slotting tool and vice versa. The design as shown was evolved specially to fit the Myford M.L.4 3½-in. lathe, but it could be adapted without major alteration to suit most lathes of similar size, and the design is also adaptable by the modification of minor features, such as the method of attachment to the bed, to almost any engineering lathe. Some users may object to having to use the top slide of the lathe as the slotting member of the attachment, and if so, a completely new slide can be constructed and attached to the vertical fixture or angle bracket. It may be mentioned that, although in the great majority of slotting operations, the stroke of the cutting tool must be exactly perpendicular to the face of the machine table, there are occasions when an angular adjustment of stroke is desirable, and in the arrangement shown, it is quite practicable to obtain this, merely by making use of the swivelling motion of the slide. In the arrangement of the slide shown, the connecting-rod is exactly vertical at the top dead centre, which gives a symmetrical harmonic motion, both up and down strokes being made at the same speed. By displacing the slide towards the front of the lathe, however, it is possible to obtain a quick return motion, the down stroke or cutting stroke being slower than the return, and therefore giving greater power leverage. For the particular purposes under consideration, however, this refinement is not considered very highly important.

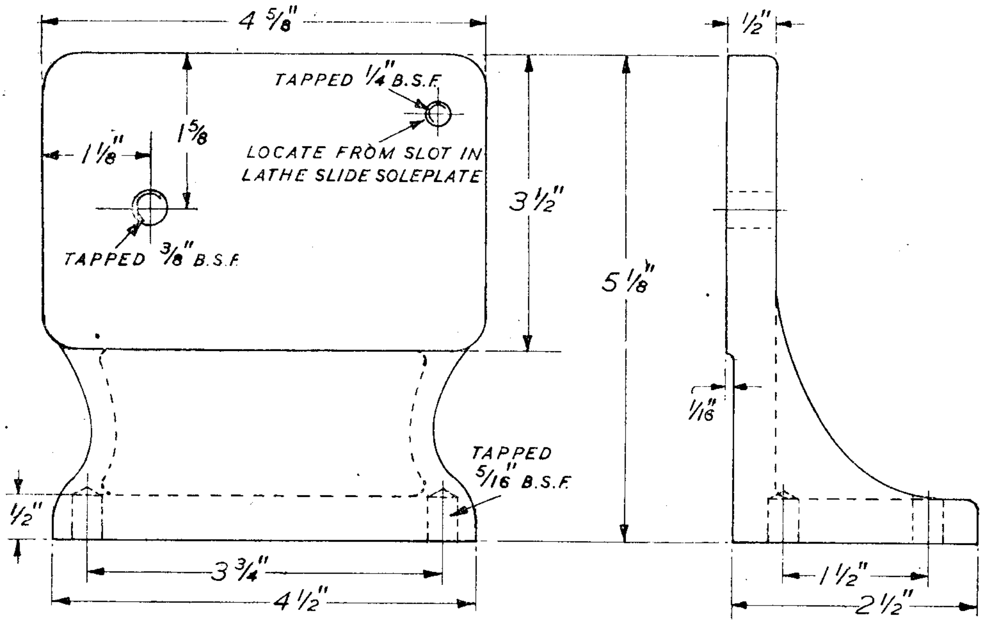
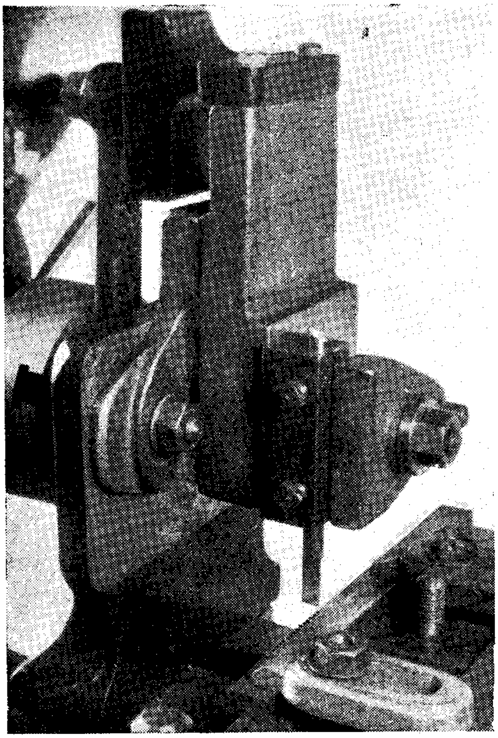


Fig. 2. Angle bracket. 1 off, cast-iron

Angle Bracket (Fig. 2)

The important feature of this component is that it should hold the slide exactly vertical over the lathe bed and provide the maximum possible rigidity of support. It is possible to adapt an ordinary angle plate to serve as this component, but unless one is content with a roughly improvised attachment for very occasional use, it will be worth while to make a special casting, or fabricate a bracket by welding heavy steel plates, not forgetting to provide some form of strut to prevent deflection of the vertical member. In the case of the casting illustrated, the minimum of machining is required, only the underside of the base and the vertical bolting face needing to be machined. For use on the M.L.7 lathe, the method of attachment to the bed by means of clamping strips shaped to fit the vees on front and back of the lathe bed (shown in Fig. 7) will be found most satisfactory, and although it is possible to attach the bracket fairly securely by a single bolt through each strip, the



Cutting a small gear rack, using a form-ground inserted-tooth silver-steel cutter

use of two bolts is recommended, in order to avoid the least possibility of "heel and toe" deflection when working. In some types of lathes it may be very convenient to hold the bracket down by means of a centre bolt passing through the bed, and in such cases, an aligning tenon should be fitted to the bracket. The clamping strips, which are not shown in detail, should be fitted in such a way that they come almost in contact with the underside face of the base, before making contact with the shears of the bed. In this way, the minimum distortion of the securing bolts is caused, and the maximum security of clamping is obtained.

The vertical face of the bracket is drilled and tapped for the swivel bolt of the slide, and also for the locking set-screw which enters the curved slot in the slide soleplate.

Other types of slide rests will, of course, call for modifications in the method of fixing. It will be seen that an aligning strip is fitted underneath the slide soleplate, attached by means of two sunk screws, and positively located by dowel pins. This strip may be left permanently in position on the angle bracket, so that whenever the attachment is fitted up for use, the correct vertical setting of the slide is obtained automatically, but it will, of course, be necessary to remove the strip, should angular adjustment of the slide in a clock-wise direction become necessary.

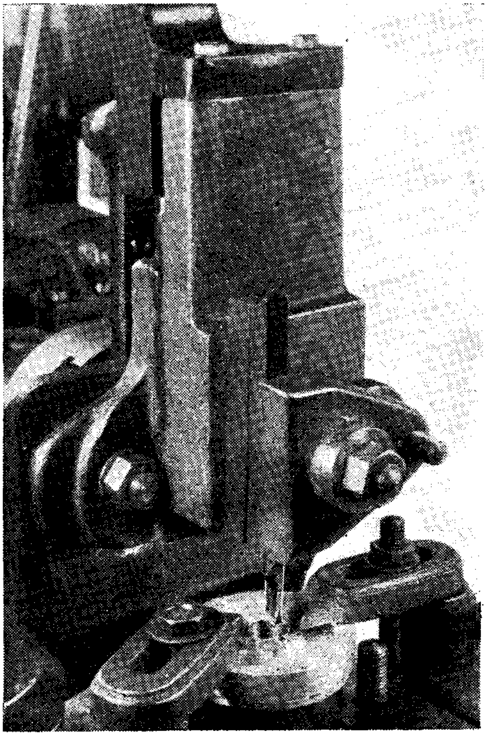
Slotted Crank Disc. (Fig. 3)

This item also is preferably made of cast-iron, though other materials may be used, and in cases where no facilities are available for cutting the T-slot across its face, some constructors may prefer to build it up from layers of sheet steel. In the latter case, it will be fairly satisfactory to rivet the assembly together with flush-fitted countersunk rivets, and machine up the entire outside surface after riveting. It is, however, a fairly simple operation to cut the slot in a solid disc by clamping the latter to the vertical face of and angle-plate held in the cross-slide with its centre exactly at lathe centre height. An end-mill run in the lathe chuck is first used to cut the slot to the required depth, after which the T-slot cutter is substituted for the end-mill and run through it at slow speed and with very slow feed.

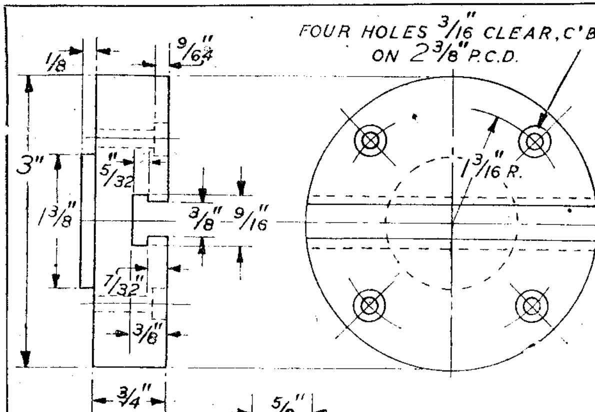
Adaptor Back Plate. (Fig. 4)

This is screwed to fit on the mandrel nose, and it should be long enough to carry the crank and connecting-rod sufficiently far away from the nose to enable the bracket to be fitted beyond the gap in the lathe bed. Beyond this, the component calls for very little comment, as its machining is quite a straightforward operation, and practically any material is suitable, though cast-iron is specified. The holes for the attachment of the crank disc may be located from the clearance holes in the latter.

It is quite practicable to dispense with the need



Cutting an internal keyway in the boss of a wheel



Above — Fig. 3. Slotted crank disc. 1 off, cast-iron or steel

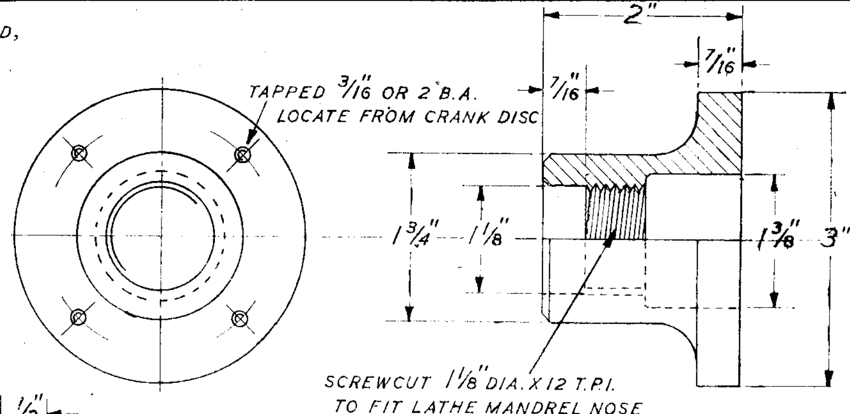


Fig. 4. Adaptor backplate to fit lathe mandrel nose. 1 off, cast-iron

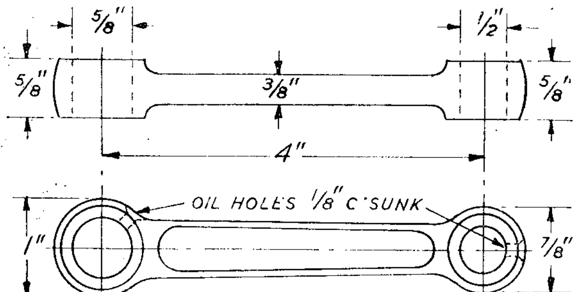


Fig. 5. Connecting-rod. 1 off, cast-iron or bronze

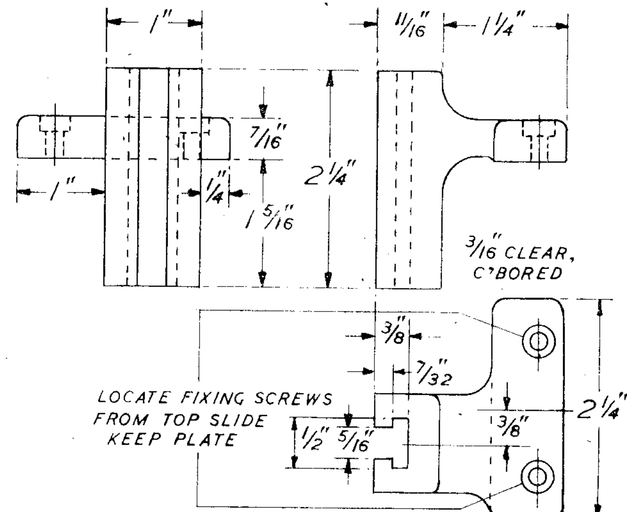


Fig. 6. Crosshead. 1 off, cast-iron

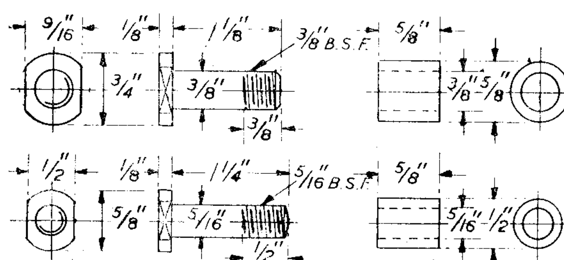


Fig. 8. Tee bolts and bushes. 1 off each, steel, case-hardened

for an adaptor plate on which to mount the crank disc, as this component can be held in a chuck, but here again, it is just a matter of how complete and self-contained the constructor wishes to make the attachment.

Connecting-rod. (Fig. 5)

This may be cast in iron or bronze, and the only point of importance about its machining is that the eyes at the two ends should be bored exactly parallel with each other. The length between centres of the eyes is not important, as adjustment for the length of stroke, and position, are provided.

It will be seen that at both ends of the connecting-rod, a steel bush is provided as the actual bearing surface of the rod, and this is held in place by means of a T-bolt. For this reason the steel bush must be made very slightly greater in length than the width of the connecting-rod bearing, so that when the T-bolt is fully tightened the rod will still be free to move on the bush. (Details of the bolts and bushes are shown in Fig. 8.)

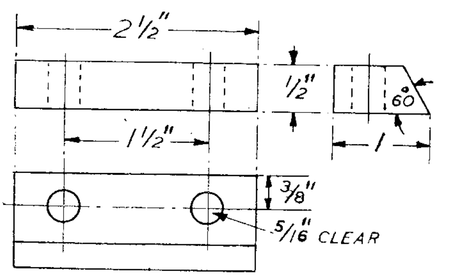


Fig. 7. Clamping strips. 2 *off, steel or cast-iron*

Crosshead. (Fig. 6)

The object of this fitting is to communicate the motion of the connecting-rod to the lathe top slide, and it is therefore arranged to fasten this to the end of the slide by the screws originally used to hold the lead screw keep plate. The crosshead is provided with a T-slot similar to that of the crank disc, and it may be machined out in exactly the same way. The essential feature in the machining of this item is that the T-slot should be exactly square with the bolting face which bears on the end of the top slide.

The stroke of the cutting tool is adjusted by slackening the T-bolt of the slotted crank and moving it to the required radius, and maximum length of stroke provided is approximately 2 in., which should be sufficient for most purposes in model engineering. The tool position may then be adjusted by the crosshead T-bolt, in such a way that the tool covers the required cutting area without any risk of running into the cross-slide or other work-holding fixture. In many classes of work, it is not desirable to cut the stroke to the bare limit, but the momentum of the moving parts may be utilised in the same way as in power presses and similar machines. This, however, can only be done when the rigidity of the vertical support is beyond suspicion, and the cut is not unduly forced. In some lathes, it may be found practicable to improve the security of the vertical support by staying the top end in some way, such as by means of a tie bolt between it and the lathe headstock.

When operating on work bolted to the cross-slide, it is, of course, essential that it should be rigidly secured by the usual methods of clamping, and where the cut is required to pass through the work, some form of packing under the work is essential, so that the tool point can pass right through, without risk of running into the cross-slide.

The cutting of internal keyways, an operation for which this attachment is very highly suited, is often facilitated by the use of an inserted tooth cutter. The cutter bit can be made from square section high-speed steel, and secured in the same manner as in a boring bar, but, of course, its position will be at right angles to that employed for a boring tool. A cutter of this type is comparatively easy to centre properly, and also easier to reset than the ordinary type of tool if it becomes necessary to regrind the tool before the operation is completed.

Another class of work for which this attachment has proved extremely useful is the cutting of small gear racks. This operation is one which very often proves difficult to carry out by a milling process, as the length of the rack which can be dealt with in this way is extremely limited. By using the slotting attachment, however, practically any length of rack can be dealt with. The pitch of the teeth is measured by the cross-slide index of the lathe, and in cases where the length of rack dealt with is greater than the maximum traverse of the slide, it is possible to reset the rack strip for a further length of cut, without very great difficulty. The tool used must, of course, be shaped to produce the correct form of rack tooth, which, for meshing with ordinary involute gears, is usually an included angle of 29 deg. Racks having oblique teeth for use on instrument slides have been cut successfully with the attachment, the angle of the teeth being obtained by swivelling the slide.

The writer is indebted to the Myford Engineering Co. for the interest which they have shown in this device, and the assistance given in its development.

For the Bookshelf

Motor Cycles and How to Manage Them. (Thirty-first Edition.) (London: Iliffe & Sons, Ltd.) Price 4s. 6d. Postage 6d.

The latest edition of this popular handbook makes its appearance at an opportune time for the motor cyclist, who is now again able to make use of his machine. Both the novice and the experienced rider will find the information in it extremely useful; it includes hints on running and maintenance of engines, transmission gear, frames and forks, tyres, brakes, and electrical equipment, and also contains chapters on overhauling, tracing troubles, and the many other small but important things which every careful user of a motor cycle should know.

The Bournville Regatta

Mr. T. Dalziel, of the home club (right), with a very interesting new "B" class boat

ON Whit-Monday, May 17th, the Bournville Model Yacht and Power Boat Club held their annual open regatta for power boats. Running was under M.P.B.A. rules and the event was well supported.

The Bournville club are the fortunate possessors of one of the finest waters in the country, and also have excellent facilities at the boat-house which enable the ladies to provide refreshments for the competitors and friends.

The day was very sunny but there was a fresh wind blowing down the lake, which caused the water to be quite choppy at the end where the circular-course events were to take place. Due to this, it was no surprise when, upon the first event commencing, a 500 yd. race for "A" class hydroplanes, competitors experienced great difficulty in staying right side up!

Mr. Meegeen (Altrincham) with *Samuel* capsized after only a quarter of a lap, and several competitors tried before Mr. Walker (Malden) with *Gilda* managed to stay the course for five laps, capsizing, however, on the following lap. Mr. Tompkinson (Altrincham) with an interesting two-stroke boat, *Rene* 5, had the misfortune to lose the contact breaker overboard; he found it again after much searching, but still could not complete the distance on his second attempt. Mr. Williams (Bournville) with *Faro*, after failure on the first run, just managed to beat *Gilda's* time on the next attempt, the result being:—

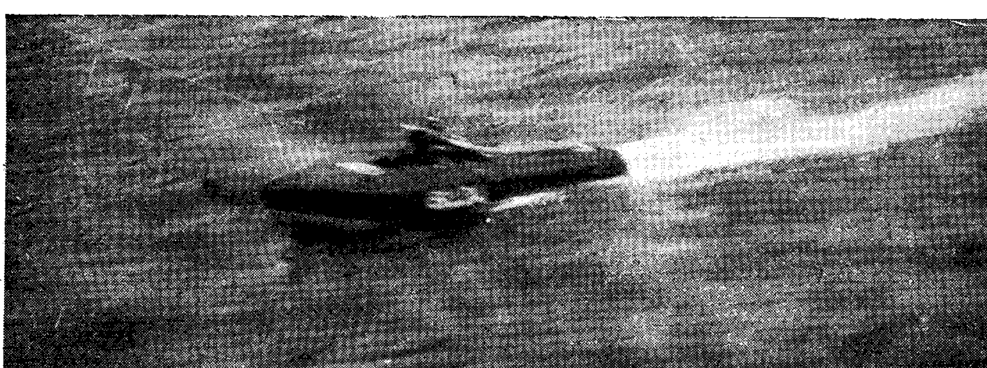
1st	Mr. Williams (Bournville)	*Faro*	32.4 sec. 31.55 m.p.h.
2nd	Mr. Walker (Malden)	*Gilda*	32.8 sec. 31.17 m.p.h.

For the next event, a 500 yd. race for class "B" boats, the water had calmed a little, but was still too rough for several boats; two flash-steamers of the Blackheath club fared poorly, one being withdrawn, and the other sinking on both attempts. The high spot of this event and indeed of the day's sport, was the striking debut of Mr. Mitchell of the Runcorn club, with a 15-c.c. four-stroke engined boat *Beta*, he put up the best speed of the day on his second try.

1st	Mr. Mitchell (Runcorn)	*Beta*	29.1 sec. 35.15 m.p.h.

No other boats completed in this race.

As can be imagined, the breeze told its story in the steering competition also, many competitors missing the target altogether. Mr. Hood



Mr. Walker's "Gilda" making a very clean run in spite of heavy weather

Mr. Meageen (left) starting " Samuel "

(Swindon) with *Truant*, who is a regular performer at regattas in all parts of the country, did fairly well, but was just beaten by the dainty steam launch of the home club, Mr. Picknell's *Gadfly*.

1st	Mr. Picknell	*Gadfly*	14 pts.
2nd	Mr. Hood	*Truant*	13 pts.

The Victoria Regatta

THE Victoria Model Steamboat Club's annual open regatta held under the auspices of the M.P.B.A. is always an interesting date for power boat fans, and this year's event, held at Victoria Park on Sunday, May 23rd, proved no exception.

The first event struck a new note for the free-running craft, being a nomination race down the lake, combined with a steering competition. The distance was about 90 yd. and several boats managed to score; the only bull scored, however, was by Mr. Brown's *Sir Roger*, thus making him the winner of the long steering. In the nomination part of the event many boats ran very close to nominated times, the final placings being as follows:

1st: Mr. Philpot, Junr. (South London), 0.25 per cent. error.

2nd: Mr. Evans (Victoria), *Maycock*, 1.0 per cent. error.

3rd: Mr. Morse (Victoria), *Belle Morss*, 2.1 per cent. error.

In the steering competition which followed, the target had been shifted to the usual steering course and perhaps, due to lack of wind, scores were good, bulls being plentiful, and this made the event quite thrilling for the spectators.

One of the first competitors to run, Mr. Curtis (Victoria), with *Micky*, scored two bulls and an inner, 13 points. Mr. Frost (Blackheath), with *Annie*, also scored 2 bulls, but had a total of 11 points only, as the first run scored an outer. Following this, hardly a boat failed to make a score of some kind and, after all boats had run, Messrs. Vanner (Victoria), *Leda III*, Morse (Victoria), *Belle Morss*, and Rayman (Blackheath), *Yvonne*, were all tying with Mr. Curtis for first place; the first re-run eliminated Mr. Morse and made Mr. Curtis the winner, a further re-run deciding second and third place.

1st: Mr. Curtis, *Micky*, 13 points plus 5.

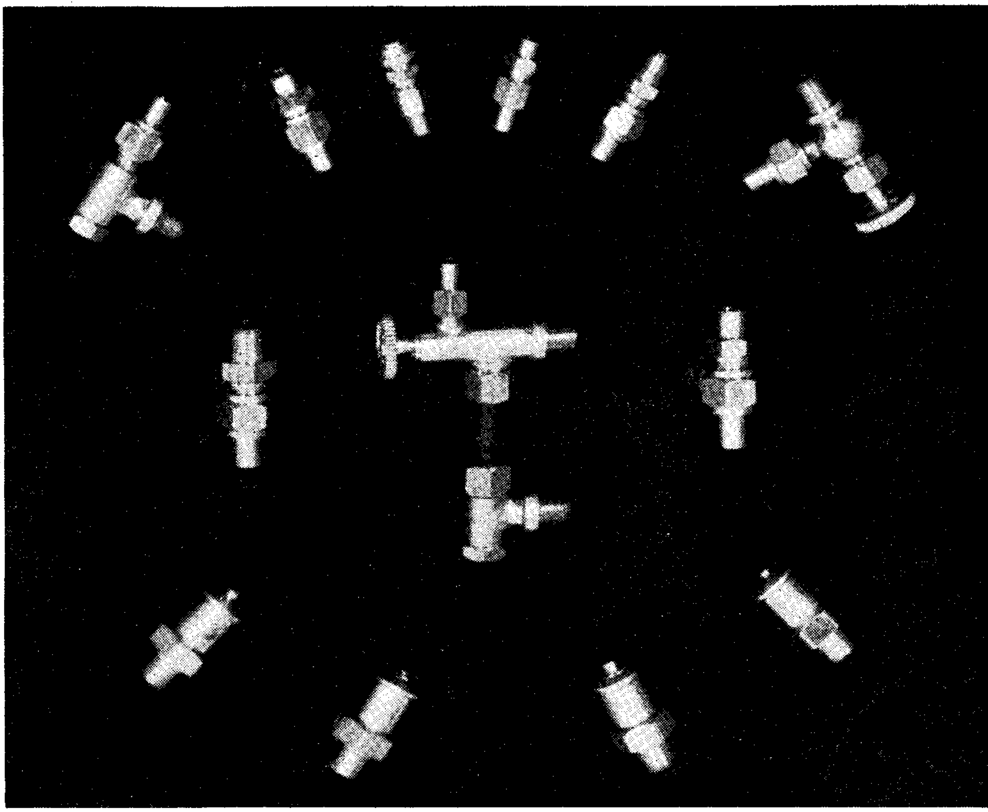
2nd: Mr. Vanner (Victoria), *Leda III*, 13 points plus 3 plus 5.

3rd: Mr. Rayman (Blackheath), *Yvonne*, 13 points plus 3 plus 3.

The lunch interval followed, and upon resumption the "B" and "C" Class hydroplanes were run together in a 300-yd. race, but separate prizes were awarded for each class. This event provided more thrills when Mr. Jutton, with his flash steamer, *Vesta II*, now fitted with a surface propeller, set up a record for this distance with

(*Continued on next page*)

Model Boiler Fittings



A NEW range of steam fittings to suit standard gauges of model locomotives and other steam engines has been introduced by Craftsmanship Models Ltd., Norfolk Road Works, Ipswich. These include special valves of the straight-through and right-angled types, non-return and check valves, elbows, unions, screwed bushes and gauge glass components.

Scale sizes and proportions are adhered to wherever possible, and standard " M.E." threads are used throughout. These components are fabricated by silver-soldering in preference to the use of castings, except in where they can be produced entirely by machining, and careful examination of such parts shows that the joints are sound, and normally invisible to the naked eye. The finish and accuracy of the fittings are very good, and the valves close positively, and produce a tight pressure seal. At the prices quoted for these fittings, they compare favourably with the majority of other makes and appear to be good value for money.

The Victoria Regatta

(*Continued from previous page*)

a speed of 43.95 m.p.h. ; the other boats entered in the race did not fare so well, no other "B" Class boat finishing the course.

"B" Class prize : Mr. Jutton (Guildford), *Vesta II*, 43.95 m.p.h.

"C" Class prize : Mr. Cruickshank (Victoria), *Defiant IV*, 23.6 m.p.h.

The last event, a 500-yd. race for "A" Class boats, also proved interesting. Suface propellers appear to be catching on. Mr. Clark (Victoria), with a new boat thus fitted put up the best speed, although the boat bounced about a lot on the earlier laps, which must have reduced the average speed. Mr. Cockman, with *Ifit VI*, repaired after a disastrous capsize at Guildford last season, also made a good showing, while Mr. Walker (Malden) with the evergreen *Gilda*, ran with usual consistency. Mr. Lines (Orpington) with *Blitz III* appeared very unstable, but managed to complete the course. The final result was :—

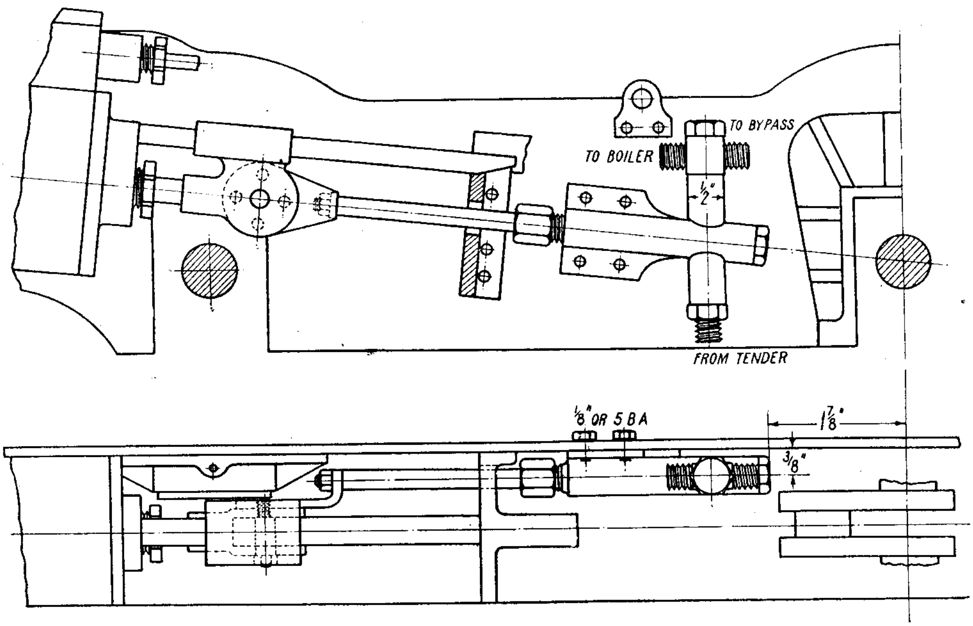
1st : Mr. Clarke, 24.85 sec., 41.2 m.p.h.
2nd : Mr. Cockman, 26.19 sec., 38.2 m.p.h.

Boiler Feed Pump for " Minx "

by " L.B.S.C."

IT looks as though scheming out feed pumps will be " getting me down," unless I'm mighty careful! I have already dissertated on the spots of bother involved in getting out a satisfactory pump for the " Maid of Kent," and thought offhand that something similar might have been worked in for the " Minx " ; but that lady lived up to her nickname, and wouldn't have it at any price. Owing to the proximity of the leading axle, the " Maid's " pump wouldn't go below the guide bars—or rather below the crossheads, as the bars are up above—and I couldn't drop it right down to clear the axle, otherwise the suction valve and pipe connections would have been at rail level. Anyway, to cut the tale short, the " hope of salvation " lay in the fact that the sides of the crossheads were clear ; and if I could arrange a drive from the side of the crosshead, that would miss the leading hornblocks and axleboxes, a crosshead pump, such as I have fitted to my L.B. & S.C.R. " Grosvenor " could be used. This was done, and the illustrations will show you how.

The pump itself is quite a simple gadget, on the lines of those designed by the immortal Billy, the principle being the same ; but it has an external screwed gland instead of the usual type of studded gland. It has only one suction and one delivery valve in place of the "three of each" arrangement fitted to the " Gladstones." It is attached to the frame by four $\frac{1}{8}$-in. or 5-B.A. screws running into a large flat flange cast integral with the pump barrel ; the latter is inclined to suit the inclination of the cylinders, but the valve-boxes are vertical. The outer end of the pump ram is reduced and screwed, and over this goes the tail end of a pear-shaped connection made from sheet metal which, in turn, is screwed to the side of the crosshead. There is plenty of room for this between the crosshead and the leading axlebox, as the plan view will show, so everything in the garden ought to be lovely. This form of drive has an advantage over that type in which the ram is screwed direct into the crosshead block, inasmuch as it provides an adjustment for alignment. If the hole in the tail of the connecting plate is made a wee bit large, the screwed end of the ram will automatically take up its correct position, and is clamped there by the retaining nut, so the pump should operate with the absolute minimum of friction.



Crosshead pump for the " Minx "

How to Machine the Pump Body

As the casting will easily swing on the average 3-in. lathe, it can be machined up in pretty much the same way as a casting to the usual pattern. About the easiest way to make a start, is to grip it in the three-jaw by its tail, and set the barrel

to run truly. Centre the end, and run up the tailstock with the centre-point in it, to steady the barrel whilst you turn the end to size, and face off as near as possible to the centre point. The tailstock can then be run back, and the die-holder put on, in place of the centre point; by aid of a $\frac{3}{8}$-in. by 32 die in the holder, the end can be well and truly threaded. Carefully face off the little ridge around the centre hole. If your chuck holds as it should do, this can easily be done, despite the amount of overhang; but if you are unlucky, and manage to get the barrel out of truth, it is easily and instantly corrected by running up the tailstock again, and entering the point into the centre hole, slightly slacking the chuck jaws whilst adjusting the barrel, and then retightening when it is set O.K. Next, with a $\frac{1}{4}$-in. drill in the tailstock chuck, drill a hole clean through the barrel. You needn't bother about drilling undersize, and reaming, as the ram should be free on this type of pump. They had plenty of clearance on the old Brighton engines. The screwed part should be $\frac{3}{8}$ in. long, but 1/32 in. either way doesn't matter; we are making a boiler feed pump, not an aeroplane component!

The pump barrel has to be counterbored for a length of $2\frac{1}{2}$ in. and the best way to hold it truly whilst doing this, is to make a tapped bush, and screw the gland end into it. Chuck any odd bit of brass rod, $\frac{1}{2}$ in. diameter or over, in the three-jaw; face the end, centre, drill right through with 11/32-in. drill, tap $\frac{3}{8}$ in. by 32 with tap in tailstock chuck (a true thread is, of course, essential) slightly countersink the end, and skim off any burr. Screw the end of the pump barrel into this, and the whole issue should run truly. Then put a letter "R" or 11/32-in. drill down, for a depth of $2\frac{1}{2}$ in. Tap the end $\frac{3}{8}$ in. by 32, slightly countersink it, and skim off any burring. Tip for beginners: when facing off anything with a big overhang, I always use a round-nose tool set crosswise in the rest, and take light cuts; a knife tool often "catches up" and tears the job, also knocks it out of truth, but the round-nose has better manners.

Next, grip the casting in the three-jaw by the bottom valve-box, with the casting as far in the chuck as it will go, and set the upper box to run truly. Face off, centre, and poke a No. 15 drill clean through the lot, cutting right across the hole in the pump barrel. Open out to $\frac{7}{16}$ in. depth with 11/32-in. drill, and bottom the hole to $\frac{9}{16}$ in. depth with a D-bit same size. Slightly countersink the end, and tap it $\frac{3}{8}$ in. by 32, taking care not to go deep enough to ruin the valve seating. Finally, put a $\frac{3}{16}$-in. parallel reamer down through the hole at the bottom of the recess.

Chuck a short bit of rod not less than $\frac{1}{2}$ in. diameter, and turn down $\frac{1}{4}$ in. at the end to $\frac{3}{8}$ in. diameter, screwing it $\frac{3}{8}$ in. by 32; screw the machined end of the valve-box on to this, when the lower end should run truly. Face off, open out to $\frac{9}{16}$ in. depth with 11/32-in. drill, countersink slightly and tap $\frac{3}{8}$ in. by 32 as above. The edge of the hole at the bottom of the recess should be nicked with a small cross-cut chisel, so that when the valve ball rises, it cannot close the hole. Run the drill down the counterbore in the pump barrel, to cut away any burrs around the drilled and reamed valve-box holes.

Valve-box Covers

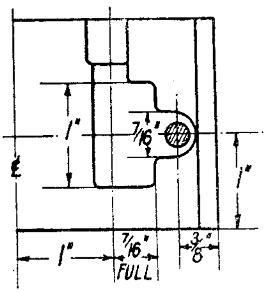
The upper cover or cap of the valve-box is formed by the stem of the tee carrying the two unions for boiler feed and by-pass pipes. A casting will be available for this. Chuck one of the union nipple bosses in three-jaw and set the other one to run truly; face, centre deeply, turn down $\frac{3}{8}$ in. of the outside to $\frac{3}{8}$ in. diameter, and screw $\frac{3}{8}$ in. by 32. Rechuck it in the tapped bush used for the pump barrel, and give the other boss a dose of the same medicine, but this time put a 5/32-in. drill clean through.

Drop a $\frac{1}{4}$-in. rustless ball in the upper valve-box, and seat it on the reamed hole by holding a bit of brass rod on it and giving just one fairly sharp crack with a hammer, resting the lower end on a block of lead, or something equally soft, to prevent damage to the faced end. Take the depth from top of ball to top of box, with a depth-gauge. Chuck the fitting by the top projection; face, centre, and drill with a 5/32-in. drill into the cross passage. Now turn the end down to $\frac{3}{8}$ in. diameter, and to a length of 1/32-in. less than indicated by the depth-gauge; the ball rises slightly into the drilled hole, so this will add the necessary amount of lift to the ball. Screw the turned part $\frac{3}{8}$ in. by 32, and cross-nick it with a watchmaker's flat file, or with a saw. Chuck by this spigot, in the tapped bush as before; face the end, centre, drill letter "R" or 11/32 in. and tap $\frac{3}{8}$ in. by 32. Screw the fitting home, so that the union nipples point fore and aft, as our nautical friends would say; then fit a cap made from $\frac{1}{2}$-in. hexagon rod, to the top, as shown. This simple job needs no detailing. Note, the screwed top is not an absolute necessity; if you like, you can just cut off the upper boss, and round it off with a file, to line up with the union nipples, leaving the fitting simply a plain double-union tee-piece. The cap, however, forms a ready means of cleaning out the pump at any time, merely by removing the cap and forcing some water through the feed pipe with a syringe. Funny things get into the pumps sometimes; once, when "Ayesha" was quite a young girl, her pump packed up completely, and when I took it apart, I found the body of a defunct ant jamming the suction valve open. The unfortunate insect had either committed suicide in the tank, or else had crawled into the end of the feed pipe whilst the feedbag was disconnected.

The lower cap forms the suction-valve seating. Chuck a bit of $\frac{1}{2}$ in. hexagon brass rod in the three-jaw; face off, centre deeply, and drill down about $\frac{7}{8}$ in. depth with No. 15 drill. Turn down $\frac{5}{16}$ in. of the outside to $\frac{3}{8}$ in. diameter, and screw $\frac{3}{8}$ in. by 32. Part off at $\frac{13}{16}$ in. from the end. Drop a $\frac{1}{4}$-in. ball in the valve-box, and take depth as above; then rechuck the embryo cap in three-jaw, blank end outwards, and turn down the end to the length indicated by the depth-gauge, screwing $\frac{3}{8}$ in. by 32. Poke a $\frac{3}{16}$-in. parallel reamer through, then face off the end for 1/32 in. which will give the ball a true seating and the proper lift. Put the ball on the hole, seat it with the hammer-and-brass-rod antic, and then assemble as shown in the section. A smear of plumbers' jointing on the threads ensures water-tightness, but be mighty careful not to get any on the ball-seatings.

The ram is a piece of $\frac{1}{4}$-in. rustless steel or phosphor-bronze rod, $3\frac{5}{8}$ in. overall length. Slightly round off one end, then reverse in chuck and turn down $\frac{5}{16}$ in. of the other end to 5/32 in. diameter, screwing 5/32 in. by 40. The gland is made from $\frac{1}{2}$-in. hexagon rod, good bronze for preference, as unlike a union nut, it has to stand up to wear. Chuck in three-jaw, face, centre, drill down $\frac{1}{2}$ in. with 15/64 in. or letter "C" drill, open out to a full $\frac{5}{16}$ in. depth with letter "R" or 11/32-in. drill, and tap $\frac{3}{8}$ in. by 32. Chamfer the corners, part off $\frac{7}{16}$ in. from the end, reverse in chuck, chamfer again, and put a $\frac{1}{4}$-in. parallel reamer through the hole.

The cap for the end of the pump barrel is made from $\frac{1}{2}$-in. hexagon brass rod, and is the same as that on the top of the union tee, except that it is drilled $\frac{1}{4}$-in. clearing (letter "F" or 17/64 in.) to the end of the thread, as shown in the section, to provide clearance for the end of the ram. To avoid any water getting trapped in the recess, cross-nick it with a warding-file right to the end of the thread, thus allowing the water free exit. Another $\frac{1}{4}$ in. on the pump barrel would have been a slight advantage, but if you look at the plan view, you'll realise why it couldn't be any longer than shown.

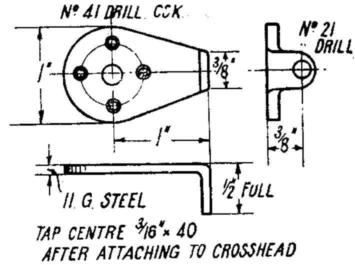


Clearances in motion plate

The contact side of the flange for bolting the pump to the frame may want smoothing off, and the easiest way for a beginner to get a true surface is to lay a flat file on the bench, and rub the flange on it. Young Curly discovered that wheeze for himself before his age reached double figures. The distance from the faced side of the flange, to the centre of the pump-ram, is $\frac{3}{8}$ in. If the casting is reasonably clean, there is no need to touch the outside of the pump barrel, nor the valve-box; they can be painted. Pack the gland either with a strand or two of unravelled hydraulic pump packing, or graphited yarn. On the L.B. & S.C.R. we used flax soaked in tallow, but this needed careful packing. If the glands were screwed up too tightly, the stuff set hard, and scored the pump rams so that they soon had a fluted surface like corduroy, and the glands leaked like old boots. The soft packings available nowadays were an unknown quantity at that time.

Driving-plate

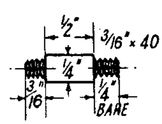
The ram is connected to the crosshead at the right-hand side of the engine, by a pear-shaped plate made from 11-gauge steel, slightly under $\frac{1}{8}$ in., to clear the leading axlebox; see plan view. If you have not already made the crossheads, this plate could be pinned and brazed on at the same time that the crossheads are assembled. The illustration gives the size and shape of the plate. Don't drill the hole in the middle until the plate is attached to the side of the crosshead by four 3/32-in. or 7-B.A. countersunk screws, which



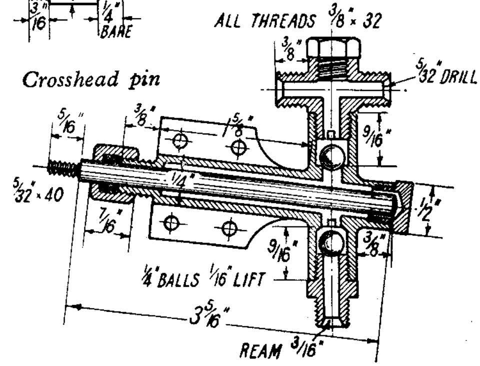
Driving plate

must not project into the recess in which the little end of the connecting-rod works, or they will jam it. The sides of the crosshead are $\frac{1}{8}$ in. thick, which is plenty enough to afford good hold for the screws, the threads of which should be a good fit in the tapped holes, to prevent any risk of coming loose when the engine is letting herself go.

If you are making the crosshead and plate at the same time, only one side of the crosshead should be drilled $\frac{1}{4}$ in. for the pin; the other side should be drilled and tapped, right through the outer side of the crosshead and the plate, as shown by the dotted lines in the plan view. The crosshead-pin should be made as per the little detail sketch, the nut being screwed on the shorter end;



Crosshead pin



Section of pump

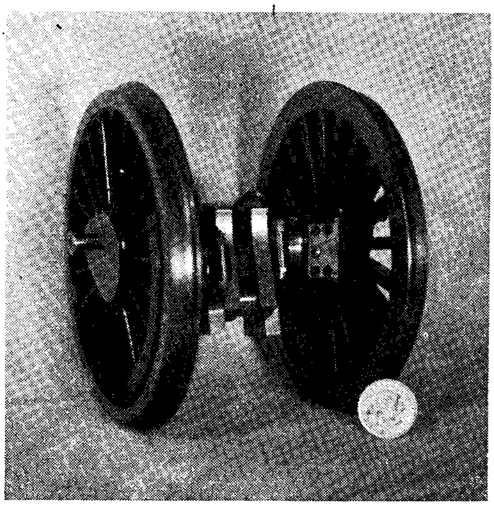
the longer end is then screwed through both crosshead side and plate, making a strong job. If the crosshead is already made, use a pin as originally illustrated. Run the $\frac{1}{4}$-in. drill through the holes in crosshead; make a countersink in the plate, follow with 5/32-in. drill, and tap $\frac{3}{16}$ in. by 40. Screw the pin into this, in lieu of the nut previously shown.

(*Continued on page* 17)

*The Story of "Centaur"

by J. I. Austen-Walton

FORTUNATELY, the keenness didn't leave me, and I saw that it paid to put in the extra work in order to obtain the extra result. So axle boxes, split and with spring-loaded felts, were well in keeping with the horns. The axle boxes were extended inside the frames more than is usual, with the extended portion turned down round to take off any suggestion of being clumsy.



The crank axle and wheels

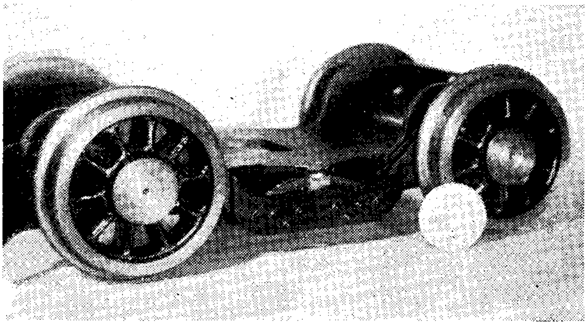
This extension certainly gave a large bearing surface and, as already mentioned, I was on the look-out for any device that would add to the wearing qualities or reduce friction.

The leading bogie was the next whole unit, and was built with full working-equaliser-beams carried on inverted semi-elliptic leaf springs, just like the prototype. The beams were built up with stainless-steel sheet, riveted and silver-soldered together, whilst the leaf spring was entirely an old clock spring, cut and punched in the hard state (easy when you know the trick), and by no means stiff and inflexible when finished. The axles themselves are stainless-steel and the wheels are in cast-iron. Coil springs look after the side control quite effectively, although, at the time of building, I feared they might be too weak.

The driving and trailing wheels and axles, made of the same materials respectively, offered no especial difficulties, although the casting of the wheels left a little to be desired. It was not too easy to get any castings during the war, and mine were cast on the understanding that I submitted single impression patterns only. This entailed having wheels with flat backs and spoke forms with the "draft" running away from back to front, and so leaving no central join with the conventional "draft angle" running away in two directions to give the approximate oval-section spoke. Apart from this drawback, the castings were extremely good and sound, and entirely free from blow-holes and exciting and unexpected cavities of unknown depth.

The next job was to provide an axle for the leading wheels. The leading axle of a three-cylinder "5 XP" happens to have a crank and an eccentric on it, to say nothing about an extra eccentric for a water-pump, and in stainless steel! Oh, well, where can I get a bit of stainless steel $3\frac{1}{2}$ in. diameter?

I found an offcut, the largest, toughest, dirtiest offcut it has ever been my pleasure [?] to handle. With teeth set and a hard glint in the eyes, I set about marking out the ends for cranks, eccentrics and all in one fell swoop. If it hadn't been for my gallant little "South Bend" I then might well have fallen by the way. But together we suffered—with each measured "galomp" as the massive billet swung round past the tool, we winced in unison—and for quite a long time. But the day came when the "South Bend" and I exchanged congratulations for having survived the ordeal without injuries to either party and the well worthwhile crank took up its position with not a little dignity!

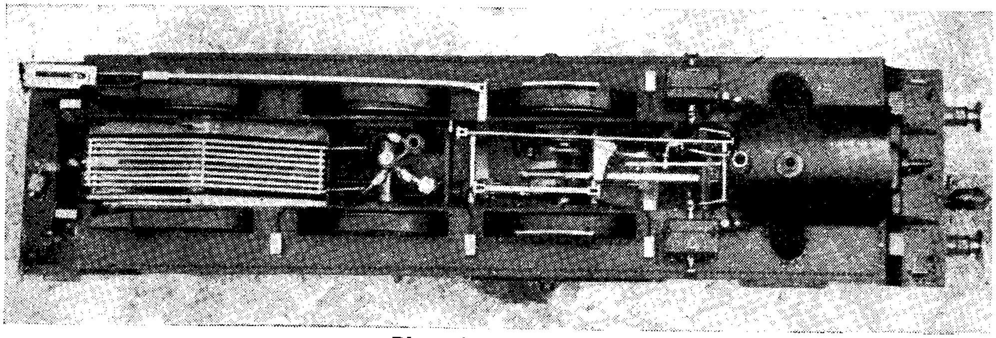


The bogie unit

By now the exacting problems of cylinders and piston-valves were pressing hard on me. So, once again, the drawing board came into its own, and I had a veritable field-day of calculations and geometry, the latter proving to be a most substantial ally as the job went on. But I had expected this and now, realising its extreme

**Continued from page 656, Vol. 98, " M.E.," June 24, 1948.*

importance, I want to put extra emphasis on the value of drawing out the whole of your valve motion in meticulous and exact detail. The procedure is not difficult and I recommend the following: Get a sheet of the very best and heaviest cartridge paper obtainable, pin it to your drawing board and, if time permits, allow it to stay a day or two to stretch and settle down. When you are ready to start, secure the paper finally with pins or sticky tape and make sure that it cannot slip or move. Then, if your board is big enough, draw out the whole of the frame outline, with wheel centres in the loaded, or theoretical running, position. It is not necessary to draw the wheels in full detail; put in the horizontal and vertical intersecting lines to show the wheel centres. Put them in, together with all the other lines, with a good, hard, sharp pencil rubbed down to a chisel point, so that you get the nearest equivalent to a scribed line on metal. Do all your drawing at least full-size for the scale you are using; or, better still, twice full-size to reduce any errors in the actual drawing. Now you can put in the cylinders in section, showing port faces, ports and valves.



Plan view of chassis

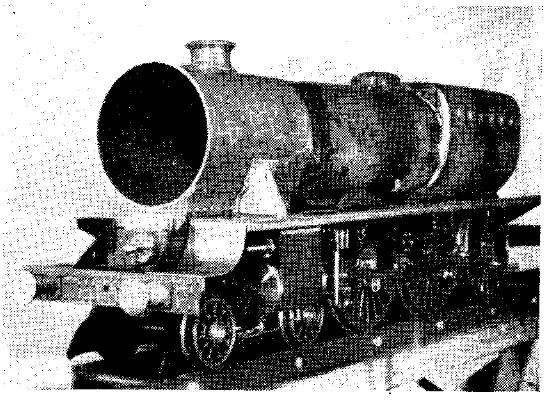
Similar "points" marked about the driving-wheel centres will give the position and throws of the cranks, and straight lines from point to point will denote the connecting and other rods, so that the term "geometry" is more in keeping than "drawing."

With the aid of large dividers, or beam compasses, the various movements can be worked out one by one. To avoid confusion at any time it is still easy to draw, in full, any rod or component likely to become confused with a near neighbour, or to put arrows and labels in coloured crayons to keep the picture lucid and quickly legible.

So satisfactory was this method when *Centaur* was built, that the valve timing dimensions of the piston-valves were taken straight from the drawing and the bobbin pinned in position on the valve-rod before assembly. A subsequent check proved the setting dead right to the proverbial hair's breadth, or finer.

During my own excursions into the valve-gear world, I evolved a piston-valve gear for outside admission, and after having examined the more obvious snags, such as the need for double glands on the valve spindles and disposed of a few minor difficulties, I was left with a system that promised to give quite a number of advantages. Not the least of these was an almost straight through and unhindered exhaust. This was brought about to some extent at the expense of the steam-feed ways; but, taking everything into account, the system balanced out with the advantages well to the fore.

So the cylinders were cast in manganese bronze, and—oh, the luxurious plutocrat! —bored with a diamond! Yes, it took a long time to live that one down; but, as I *had* the diamond anyway, it was a pity not to use it for that job. And what a finish! It seemed a shame even to touch the surface afterwards, but the result was there—parallel and flawless, so I couldn't go wrong. Incidentally, the piston heads were cast as separate units, bolting together on the machined flat faces, and bringing the weight of the job down for easier handling and machining.



Boiler and chassis try-up

I had also envisaged the possibility of the piston-valves not working according to plan, so, had such an emergency arisen, the conversion to slide-valves would have been easy, especially with the return-crank already set as for slide-

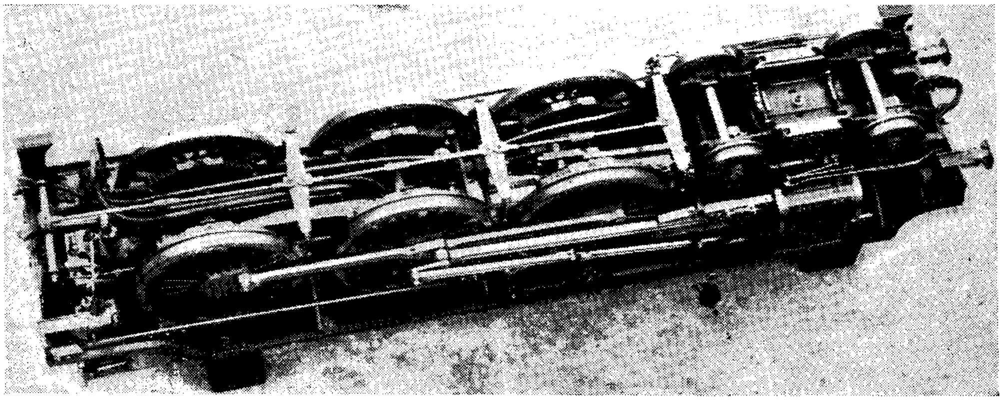
valves, which is the same for piston-valves when the admission is outside. I have already related the sad story of the piston-rings, showing that things don't always work out according to plan.

The piston-valve heads, also cast in manganese bronze, were bored through with a normal tool and deep square grooves turned at the port positions. Sleeves, made from extra-hard chilled bronze, were then turned up with the steam ways broken through in a series of round-ended slots giving a number of supporting "spiders" to allow the valve bobbin a comfortable and bump-proof travel over the ports. I still believe this to be the ideal method, and the running of *Centaur* has proved—at least, to my own satisfaction—that the piston-valves are really successful. The bobbins are made in stainless steel, and calculations were made covering the expansion angle.

Some people say that stainless steel does not wear well, but I am convinced that it is the finish that is imparted to the surface that can make or mar the job. This material, when turned, has the property of developing a loose, rough surface—even when still having the appearance of being well polished. Parts that call for exacting fits, such as piston-valves, should be finally rolled down to size, leaving little more than two to three tenths of a thousandth for the process. I used a small ball-race running in a forked rod and held in the tool post. Using moderate pressure, roughly equivalent to that required for light knurling, the time required to reduce the diameter by one tenth was about seven or eight minutes at 300 r.p.m.

Centaur's piston-valves, when finished, would not quite enter the sleeves, but, after an hour's lapping with nothing more vicious than colloidal graphite running-in compound, they would slide easily from end to end. Even then, a bobbin warm from the hand would not enter a cold sleeve, and I felt that clearances were at their closest limit.

Then came the whole of the motion work, coupling-rods, expansion-links, crossheads and guide-bars, etc. At that time, flat stainless bar was difficult to get, so the coupling- and connecting-rods, unfortunately, had to be made in cast steel. These are quite normal, fluted on the outside faces only for strength reasons, but otherwise in accordance with the prototype, and call for no special mention. I was more fortunate in the case of eccentric-rods, radius-rods, crossheads, return-cranks, combination and union-links, which are all stainless, leaving expansion-links and guide-bars in cast steel. I was glad of the latter, owing to the definite need for hardening this part—a treatment to which stainless will not respond.



View underneath chassis

The expansion-links are open-sided and supported by a single trunnion, but the heavy wear bogey has been scotched by using two sets of very small ball-races spaced well apart on each trunnion. The open-sided link gives definite advantages for servicing an engine, for it is then possible to lift off the greater part of the motion without having to free too many forks and remove hard-to-get-at pins. The crossheads are provided with inserted bronze slippers held down with small screws, to facilitate removal if necessary, while the guide-bars have criss-cross channels milled down their length to assist oil distribution.

The valve crossheads have called forth many and varied comments, for it was noted that this item did not appear according to her big sisters. But there is a reason for their form.

The usual crosshead guide gives excellent support up and down, countering the angularity of the radius rod and consequently the offset of the thrust; but it is not designed to counter any great thrust in a horizontal plane.

On a full-size locomotive there is not much horizontal offset to counter, due to the slight up-and-down movement of the wheels compared with a wheel movement that is considerable in the small-scale version, especially on an uneven home or portable track. *Centaur's* guides are of drum type and are adjustable, covering thrust from all directions with equal efficiency. Knowing that the piston-valves were, in a sense, on trial, I endeavoured to make sure that no outside inequalities would bias the working of the valves to give a false impression of their efficiency and resistance to hard usage.

Before leaving the cylinder story entirely, it might be as well to include the priming cock installation for, with piston-valves and a really heavy engine, they become a genuine necessity. All three cylinders are fitted with valves of the plug-cock pattern with the plugs turned to a more obtuse angle than usual. This, to a great extent, prevents the jamming worry, even when the plugs are held in quite tightly. All the cocks are made to the orthodox pattern with the square end and squared washer and nut. The tiny crank arms fit on the square shanks in the same way. Links connect them in pairs, and a perfectly venomous but indispensable series of links, rods and cranks eventually dodge innumerable and immovable obstacles to arrive safely at the cab, complete with lever. Strange to say it works, and works well, without the feeling of lots of spring and lost motion which one might expect from such a devious route.

One of the transmission points is at a bell-crank which is left free to move about a short shaft running across the frames. This shaft serves a double purpose, being rocked to and fro by a fixed crank on it, which is, in turn, operated from the inside expansion-link. Further cranks pinned on to both outside extremities of the shaft serve to operate the two mechanical lubricators, so that the unsightly levers and ratchets face inside, and do not spoil the appearance of the job. The shafts of the lubricators were extended through the oil-boxes and fitted with hand-wheels of modest proportions so that the little extra oil could be twisted in from outside should the need arise.

From the structural point of view there is little else to describe about the lower works. The brake shoes were made in the time-honoured way by cutting them out of a turned ring after a parting-tool had formed the outside groove, whilst brake-rods and forks, all in stainless steel and with left- and right-hand threads for adjustment, bring us back to the brake-cylinder and brake-valves.

The brake-cylinder is more or less normal, having a packed piston; steam is admitted to the top of the cylinder, pushing down. The lower half of the cylinder is not free to atmosphere and the piston-rod passes through a gland. This offers the opportunity of using the lower half of the cylinder for vacuum operation, should this refinement be added at a future date. At present, the pipe and union of the bottom connection are used merely for draining purposes, and are, in this application, open to atmosphere.

The feed-pipe to the cylinder also feeds two trunk-pipes, one running to the front of the loco and terminating in the flexible and normally blanked-off train-pipe. The other runs *via* a flexible union to its counterpart at the rear of the tender. Thus, either front or back connections could be used to carry on a live-steam brake system to the train or trucks.

(*To be continued*)

"L.B.S.C."

(*Continued from page* 13)

How to Erect the Pump

Clearance will be necessary in the motion-plate, to allow the pump ram and the driving-plate to pass; and this can be made with a file, to the dimensions shown in the illustration of half the motion-plate. It won't unduly weaken it in the case of the "Minx," as it leaves less "open work" than there is on the "Maid's" motion-plate. Next drill the screwholes in the frame. These are located $\frac{7}{16}$ in. above and below the centre-line of motion; the first pair $1\frac{3}{8}$ in. from the back of the motion-plate, and the second pair behind the first. Use No. 30 drill, and file off any burrs inside frame.

The pump will locate itself; the one I fitted to "Grosvenor" did, and that was a far more ticklish job than the one shown here. Put the crank on back dead centre so that the piston-rod is fully extended. Push the pump-ram right home, and put the whole issue in place, sliding it forward until the screwed end of the ram enters the hole in the tail of the plate. Hold the flange of the pump tightly against the frame, and put on the nut. Now pull the pump back $\frac{1}{16}$ in., giving it that much clearance between the end of the ram and the plug at the end of the barrel. Let it go quite free, so that it can line itself up to the crosshead; then put a toolmaker's cramp over frame and pump-flange, run the No. 30 drill through holes in frame, making countersinks on the flange. Follow up with No. 40, tap $\frac{1}{8}$ in. or 5-B.A., put in four hexagon or round-head screws, and Bob's your uncle. When the wheels are turned by hand, the ram should slide easily the full length of the stroke; there is less friction, really, than in the case of an eccentric-driven pump, as the gland is so much smaller, there is no eccentric, and the only bearing surface is the short bit behind the gland.

The "Sunny Jim" behind these crosshead pumps is amazing. When I tested "Grosvenor's," in the kitchen sink, by hand, it was impossible to prevent water coming out of the union nipples by finger-and-thumb pressure, when the ram was pushed in; that pump has a $\frac{1}{8}$-in. ram with a stroke of $1\frac{1}{2}$ in. The pump will work well at any speed, owing to the clearance around the ram, and the big waterways, as on the full-sized Stroudley pumps. Well, having described two pumps in response to requests to include pump feed, personally I wouldn't bother about fitting one at all, but would use two injectors, which save a lot of trouble, work perfectly if kept clean, and entail no moving parts and no by-passes.

In case any beginner thinks that this crosshead pump eliminates any need for the middle eccentric, it certainly doesn't; we shall need that for operating the mechanical lubricator, which it will drive *via* an intermediate lever and suitable connecting-rod.

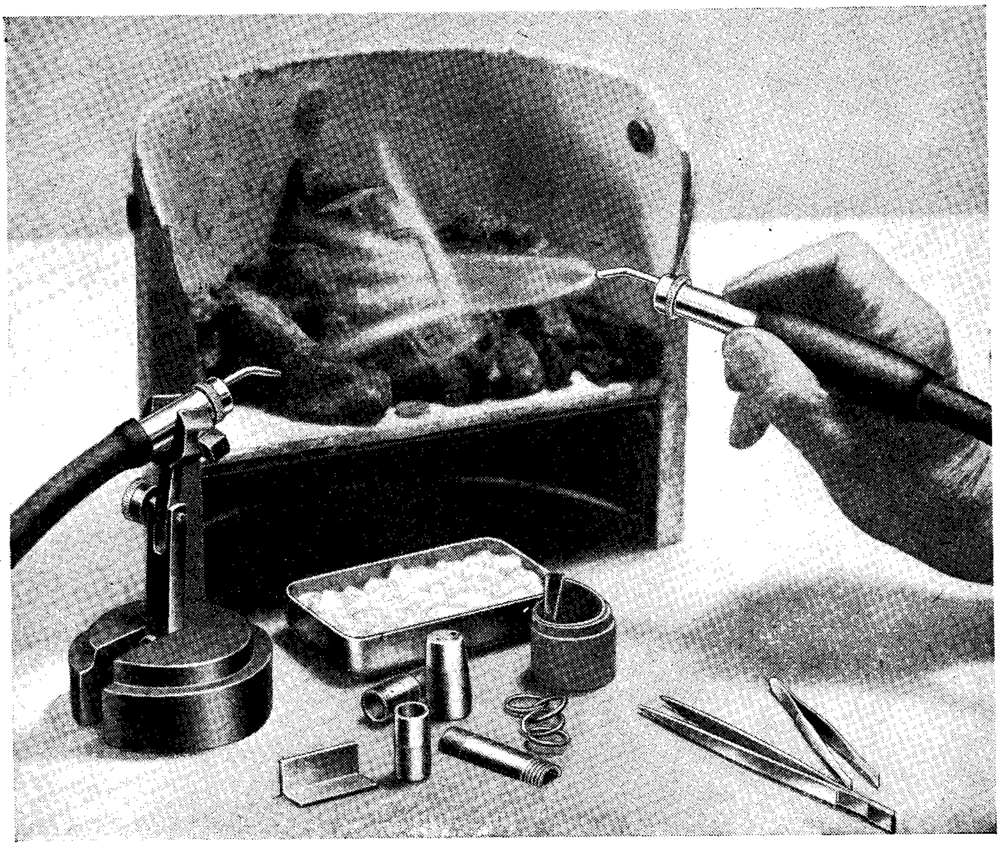
" Spitfire " Gas Blow-Lamps

WE have recently tested out samples of these simple and inexpensive devices, which are extremely useful for all jobs in the amateur workshop which require the application of heat. The principle on which they operate is fairly well known, and consists in the use of two gas jets, one burning at a relatively low velocity, while the other impinges across it obliquely at a high velocity. The effect is to direct the flame to a fine point, also to increase the intensity of heat by inducing extra oxygen into the core of the flame.

These blow-lamps, or more correctly, blow-pipes, can be connected to any gas supply, but demand a fairly high gas pressure to work to full advantage. Therefore, they should be fed from a pipe of ample bore, and with the tap turned full on.

Two types of the appliance are available, one with moderate size jets for normal purposes, and the other having specially fine jets for small work. The jets may need occasional cleaning, through clogging by foreign matter, but care must be taken not to enlarge or deform them by forcing large wires or needles into them Symptoms of clogging are a weak or diffused flame, or a tendency to " light back " at the injector jet.

We have tried out these appliances quite successfully for tempering small drills and cutters, and for soft soldering, silver soldering and brazing of light work. They are produced by Greerton Patents and Engineering, Greerton Works, Nichols Street, Leicester, and are obtainable from most tool dealers and engineering supply stores.



The " Spitfire " gas blow-lamps in operation

IN THE WORKSHOP

by "Duplex"

14—An Auxiliary Bench Vice

IT seems to be generally accepted that for all-round work the top of the jaws of the bench-mounted vice should be at the level of the tip of the elbow; although when heavy filing work is encountered the weight of the body can be used to better advantage if the vice is placed at a slightly lower level, or the operator stands on a low platform.

For light filing, on the other hand, it is certainly preferable to have the work at a higher level, both to bring the work nearer to the eye without the operator having to stoop, and also to allow the arms to make more delicate filing movements while the body is maintained in the nearly upright position.

Again, the ordinary large bench vice, which is essential for heavy work, is not always adapted to swivel, but many light filing operations are greatly facilitated when a turntable is fitted.

To overcome these shortcomings and to provide a more upright working position, as well as a swivelling movement, for light and critical filing, a small auxiliary vice, fitted with a turntable, can be secured in the main vice and used to hold the work.

For this purpose, during the past twenty-five years we have used a small Yankee type swivelling vice, as illustrated in Fig. 1; and to enable the base to be gripped in the jaws of the bench vice a clamping-piece, as shown in the drawing, was bolted to the base.

Recently, the cast-iron turntable of the small vice broke, apparently as a result of old age and not due to ill use.

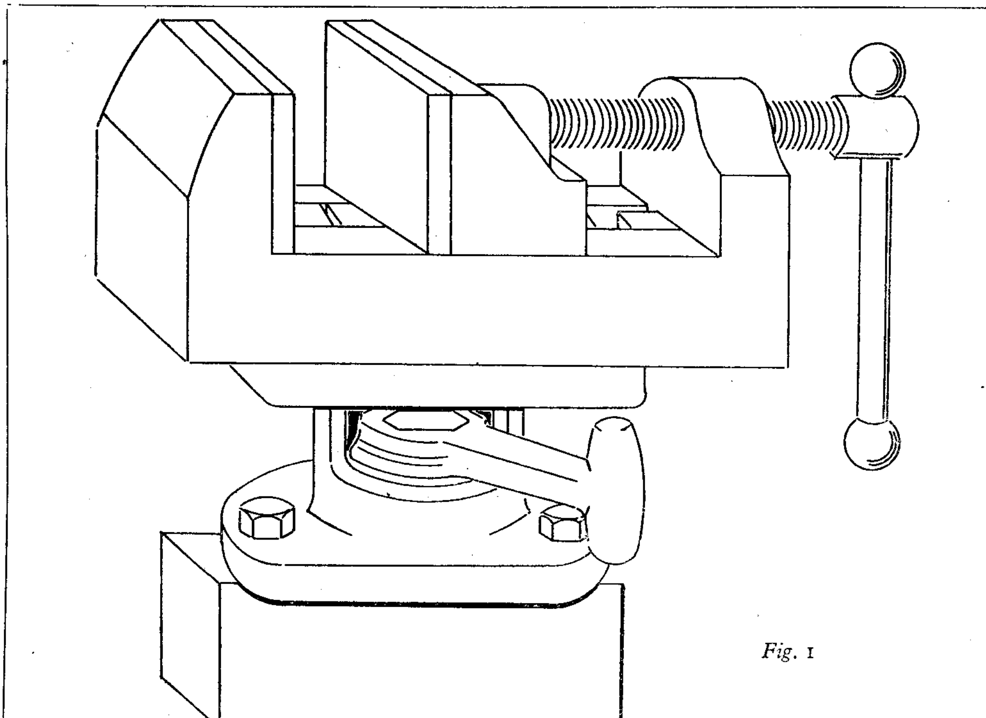


Fig. 1

As the vice itself was in good condition, it was overhauled, and after it had been furbished up to give it a new appearance, it was set aside as an additional machine vice for use on the table of a small sensitive drilling machine.

A search in the cupboard containing displaced tools brought to light a very well-made bench vice with jaws of 2 in. width, which had been bought new fifty years previously for five shillings.

As this vice was in excellent condition, except as regards its paint work, it was decided to fit it with a turntable for mounting in the large bench vice.

This vice is illustrated in Fig. 2, and although not shown in the drawing in order to avoid complication, the saddle casting carrying the

back jaw is secured to the base by means of four bolts, as was the common practice at the time.

This form of construction has certain advantages, although it may possibly be claimed that it is not as strong as the more modern design with the saddle-piece cast integrally with the base; nevertheless, this vice in its young days successfully supported the flywheel of a 6 h.p. car engine while a keyway was filed in the bore, and one rather suspects that the modern practice reduces manufacturing costs.

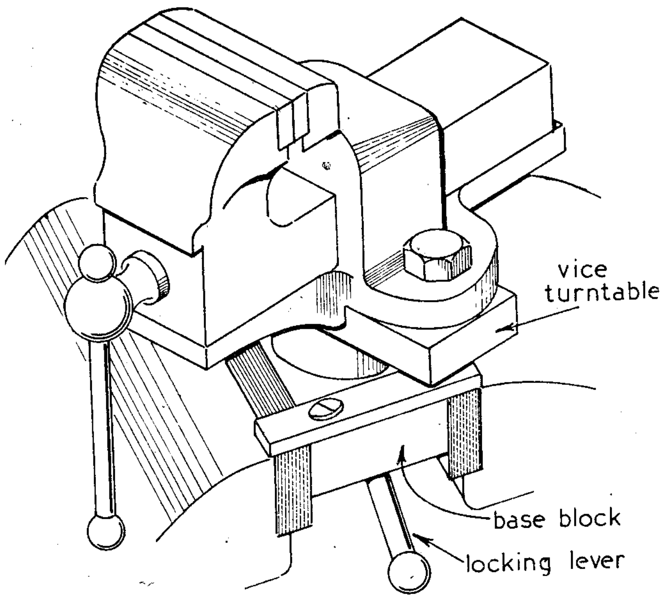


Fig. 2

Next, the scrap box was searched for material to make the upper part of the swivel base, indicated as the vice turntable in Fig. 2, and for the sake of clarity shown with square corners, but these should be rounded off to conform to the base of the vice.

This part is also shown as (1) in Figs. 3 and 4.

Luckily, a heavy cast-iron fitting was found which was intended to carry the conduit to a large iron-clad switch box; fortunately, it had not been bored for the conduit tubing, and surprisingly, the two bolt holes were spaced only a few thousandths of an inch apart than those in the base of the vice.

The contact surface of the casting had been machined and was found to be flat. The casting was then attached to the base of the vice with a single $\frac{5}{16}$-in. bolt, and after a drill had been passed through the other hole the second bolt was inserted.

Before going further, let us turn to Figs. 3 and 4 to see the construction of the whole device and its method of working.

The turntable (1), which is bolted to the base of the vice, rotates on the base block (2) with the bolt (3) acting as a pivot.

These two parts are secured, when the vice is in use, by means of the clamp nut (4) actuated by the locking lever (5).

As shown in Fig. 2, the range of movement of the locking lever is limited by the vice jaws; it is necessary, therefore, to prevent the pivot bolt turning in the base block, by means of a key, to ensure that the locking lever will always operate effectively within the limits of the gap between the vice jaws.

The position of the base block in the vice is maintained by two supporting strips attached at either end and bearing on the upper surface of the jaws.

Machining the Parts

The machining of the turntable (1) was first taken in hand, and as the casting previously mentioned was too irregular in shape to allow it to be held in the four-jaw chuck, it was, instead, bolted to the driver plate which screws on to the mandrel nose of the lathe. A spare driver plate is kept for mounting work of this sort having two symmetrically placed holes; as depicted in Fig. 5, two slots are formed in the plate to allow for varying bolt centre distances and also to afford a range of adjustment. In addition, the plate can be drilled and tapped, as required, for holding work of irregular shape or for the purpose of attaching fittings such as those used for eccentric turning.

When the turntable had been secured by two $\frac{5}{16}$-in. bolts with its upper surface in contact with the driver plate, the lower surface of the boss was first faced and then drilled $\frac{7}{16}$ in. with the drill mounted in the lathe tailstock chuck.

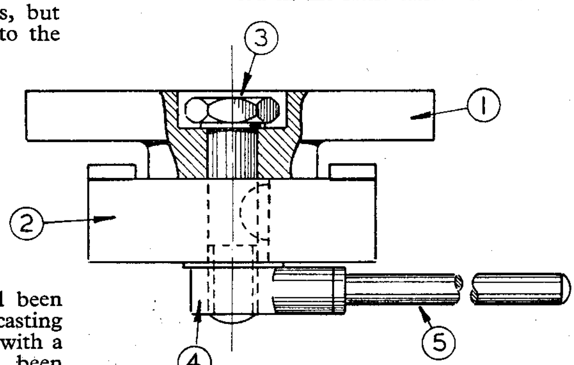


Fig. 3

Finally, this hole was enlarged to $\frac{1}{2}$ in. clearing size with a small boring tool secured in the lathe tool post.

The next step was to reverse the casting on the driver plate for boring the recess to receive the head of the pivot bolt.

The two $\frac{5}{16}$-in. holding-down bolts were again used, but care must be taken to ensure that the narrow turned face lies evenly and is not tipped to either side by unequal tightening of the bolts. This is, perhaps, best carried out by inserting a cigarette paper under the boss at either side opposite the two bolts; even tightening of the bolts will then cause both papers to $\frac{1}{2}$ in. clearing size; the recess for the head of the pivot bolt is then formed with a boring tool.

When the part has been reversed in the chuck, the boss is turned, in accordance with the drawing, to a depth sufficient to ensure that when the vice is rotated the nuts of the attachment bolts will clear the strips fixed to the base block.

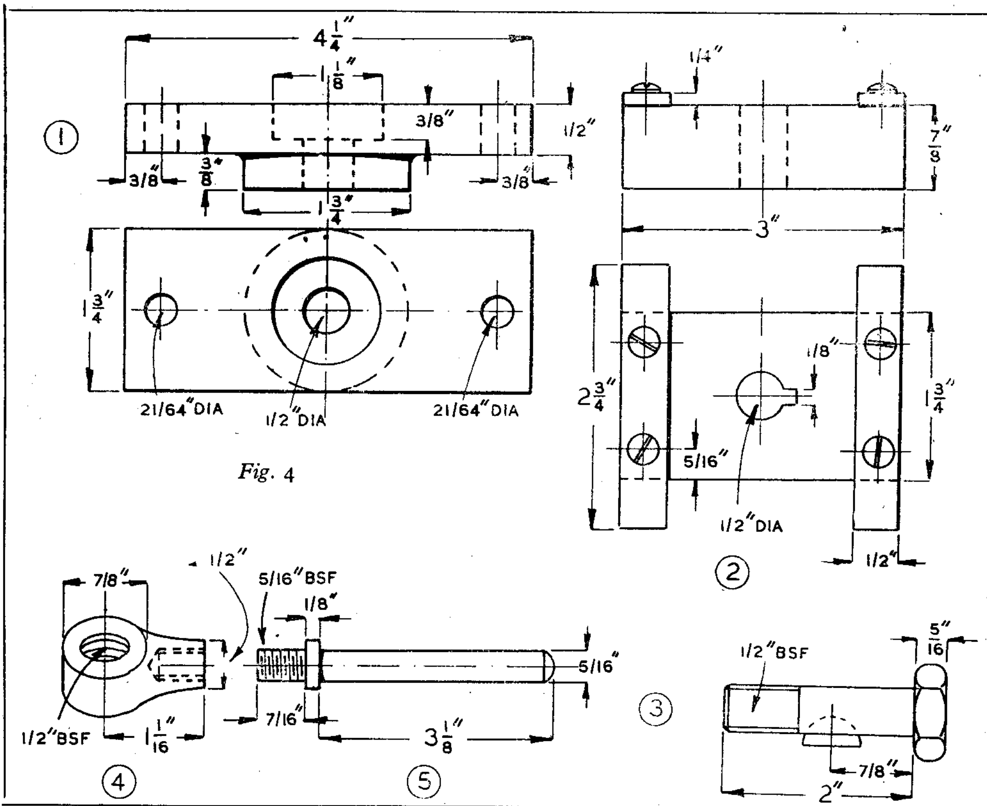


Fig. 4

to be firmly gripped, and the casting will then be squarely held and accurately positioned if, at the same time, the bore is set to run truly.

The recess is then machined with a boring tool to give both radial and end clearance for the head of the pivot bolt.

While the casting is mounted in this position, a light facing cut should be taken right across its bearing face to make sure that it will make proper contact with the under surface of the base of the vice.

Where a suitable casting is not available, the turntable can be made from a length of steel bar, or other material of adequate size; this can be readily mounted in the four-jaw chuck for machining. In this case, the material is first marked-out, and the bolt holes and the pivot holes drilled; the latter should be drilled somewhat undersize to allow for machining later.

The work is gripped in the chuck with the pivot hole set to run truly, and this hole is bored

The base block (2) can be made from a piece of material similar to that used for the turntable, and after being marked-out it is bored to $\frac{1}{2}$ in. clearing size and then faced on its upper and lower surfaces in the same manner as the turntable.

To save waste of material, a standard $\frac{1}{2}$-in. Whitworth bolt, 2 in. in length was used for the pivot member (3), but, if desired, this part can be turned from a length of $\frac{3}{4}$ in. diameter round bar, as a hexagon head is not required.

The clamp nut (4) is made from a piece of mild-steel bar, $\frac{7}{8}$ in. wide and $\frac{1}{2}$ in. thick, and it can be threaded either $\frac{1}{2}$ in. Whitworth or $\frac{1}{2}$ in. B.S.F. A punch mark should be made to indicate the face abutting against the base block to avoid any uncertainty when assembling the parts at a later stage for marking the position of the key and keyway.

The shouldered locking lever (5) may be formed either parallel, tapered, or with a ball end, to suit individual taste.

The parts should now be assembled, with a washer under the clamp nut, and, when the base block has been clamped in the vice, the pivot bolt is turned until the turntable is left just free to revolve, with the locking lever in contact with the near vice jaw. It will then be found that the turntable is firmly secured when the locking lever is moved approximately into the position shown in Fig. 2.

While the parts are still assembled in this position, the exact location of the pivot bolt in relation to the base block is marked, in order to enable the key to be fitted in the correct place.

Although the pivot bolt has but little tendency to turn as the clamp nut is tightened, nevertheless, a Woodruff key as shown in Figs. 3 and 4 (3) will provide the ideal means of preventing rotation, and will, at the same time, best resist wear.

The key seat in the bolt can be machined with either a Woodruff milling cutter specially made for the purpose, or a fly-cutter can be used when adjusted in its holder to the correct radius to match the key.

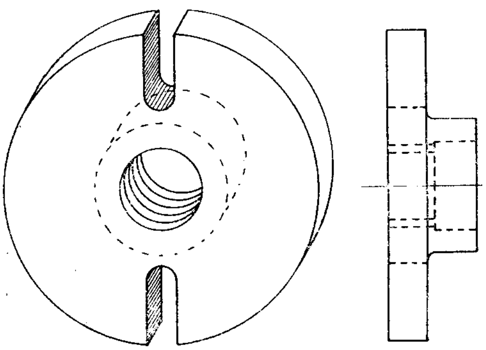


Fig. 5

An alternative method of preventing rotation of the pivot bolt is to cross-drill it with a No. 31 drill and then to ream the hole to $\frac{1}{8}$ in.; a cross-pin $\frac{3}{4}$ in. long made of $\frac{1}{8}$ in. diameter silver-steel, is then fitted to allow a push fit.

It will be appreciated that, if the key or the pin are readily removable, they can be fitted in place quite easily after the bolt itself has been passed through the turntable, otherwise it may be found necessary to cut a slot in the turntable to allow the key to pass when assembling the parts.

The next step is to cut the keyway in the base-block; and where a cross-pin is used, two keyways will be required to accommodate the two projecting ends of the pin.

The keyway or keyways must be marked-out in the correct position by referring to the marks made earlier on the bolt and on the base-block. When forming the keyway, the bulk of the metal can be removed by drilling a $\frac{1}{8}$ in. diameter hole from a centre punch-marked slightly more than $\frac{1}{16}$ in. from the edge of the bore.

As in this case no great accuracy is necessary in the fitting of the keyway, it can be finished by filing, or as an alternative and rather quicker method the keyway can be cut with a hacksaw.

Special thick blades are made for this purpose, and as they are $\frac{1}{8}$ in. wide they can be threaded through the bore and then secured in the hacksaw frame.

If an $\frac{1}{8}$-in. blade is not available, two or more blades can be used side by side to make up the correct thickness, but it will be found that, as the blade-hooks of the hacksaw frame are usually set at an angle, only one blade at a time can be properly tensioned.

To overcome this difficulty, the blades can be clamped together in two toolmakers' clamps, but as the blades are not then in tension, the clamps should be placed sufficiently close together to ensure that the blades are not readily bent and broken when in use. It will usually be found that the sawing process is made easier if the blades are mounted so that they cut when pulled towards the operator.

As mentioned above, if the key is firmly secured in the bolt, an additional keyway should be cut in a similar manner in the turntable to facilitate removal of the pivot bolt.

The two strips, made of $\frac{1}{2}$ in. by $\frac{1}{8}$ in. material, which maintain the base-block in position between the jaws of the bench vice, are attached to either end of the base-block with 2-B.A. screws; if round-headed screws are used, the strips will be weakened less than if countersunk screws are employed. Care must be taken to position these screws so that their heads do not foul the nuts of the attachment bolts as the turntable is rotated.

Finishing Vice Jaws

Although roughened jaw-pieces are usually fitted to vices, they are quite unnecessary in a small vice of this type where great gripping power is not required, and damage to the work can only be avoided by using proper vice clams.

The gripping surfaces of the jaws should be rendered smooth, either by grinding the insets in a surface grinder, or by filing them after they have been softened by heating.

If desired, soft jaw-pieces can be fitted and kept true by occasional filing of the gripping surfaces; this will save the inconvenience of using copper clams, for pieces of thin card will then be sufficient to protect the surface of finished work from damage.

This completes the constructional work, but should an old vice be fitted to the turntable, it is as well to strip it down and give it a thorough cleaning and oiling.

The worn upper surface of the jaws can, where necessary, be restored by filing, but if the jaw-pieces are fully hardened they will have to be carefully ground true with the aid of a grinding rest, unless, of course, they are first softened and then filed true while in place.

Lastly, the jaws are finished by using a strip of emery cloth held against the blade of a flat file.

Painting the Work

It now only remains to paint the swivel mounting and the vice, too, if its paintwork is not in good condition.

All old paint should be stripped off and the surface cleaned with emery cloth followed by

rubbing with a clean rag soaked in lighter fluid.

For general use in the workshop, cellulose paint will be found most satisfactory, as it does not stain with oil and is also very resistant to damage.

On the whole, elephant or battleship grey is, perhaps, the most satisfactory colour to use when painting the workshop tools and machines. If paint of the required shade cannot be bought, a grey can be obtained by mixing equal parts of black and white paint, and the proportion of one or the other can be increased to give a dark or a light grey respectively.

A more pleasing tint results if a small quantity of blue paint is added to the mixture.

For large surfaces it is better to apply the paint by spray painting, as this saves time and enables several coats to be given to the work without risk of removing the paint already applied; but with a little practice very good results can be obtained by brush painting smaller parts.

When the paint has set firmly, the shininess should be removed by gently rubbing the surface with a soft rag to which liquid metal polish has been applied; this removes any surface marks and at the same time imparts a pleasing glossy finish.

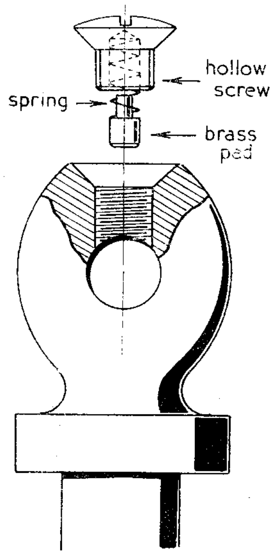


Fig. 6

A Vice Handle Detent

It will at times be found a great convenience if the vice handle can be made to stay in a certain position so as not to interfere with the work, instead of always falling downwards by its own weight.

This is, perhaps, best ensured by fitting some form of friction pad controlled by a spring.

Fig. 6 illustrates a neat and simple method of carrying this out, but at the outset the vice handle should be removed by unscrewing one of its knobs.

In the case of a small vice fitted with a handle $\frac{5}{16}$ in. in diameter, a 2-B.A. compression screw was used.

This screw was specially made for the purpose from a piece of $\frac{1}{4}$ in. diameter rod turned in the lathe, and, at the same time, the screw was drilled axially, as shown in the drawing, with a No. 33 drill to accommodate a short length of rather stiff petrol lighter spring.

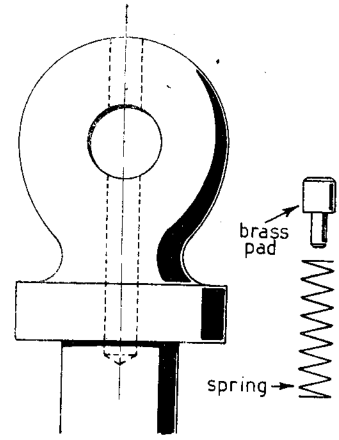


Fig. 7

A brass contact pad-piece was turned with a shank to fit the bore of the spring. When the parts are assembled, the spring pressure should be sufficient to maintain the vice handle in any position in spite of any vibration that may arise when working.

Where there is sufficient metal in the shank of the head of the vice screw, the following method may be preferred.

If a similar spring is used as in the previous case, a No. 33 hole is drilled, as shown in Fig. 7, across the central hole and into the shank of the vice screw for a depth sufficient to house the pad-piece and the spring.

When the latter components have been inserted so as to bottom in the hole, the pad-piece is pressed down with the blade of a screwdriver, and the vice handle is then fitted in place to complete the work.

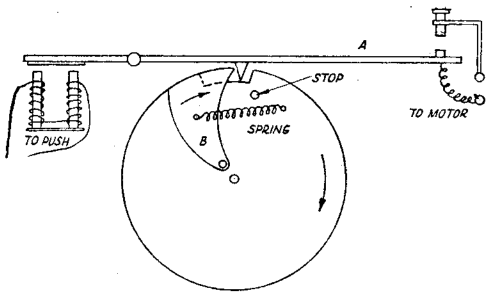
Newton Abbot Calling

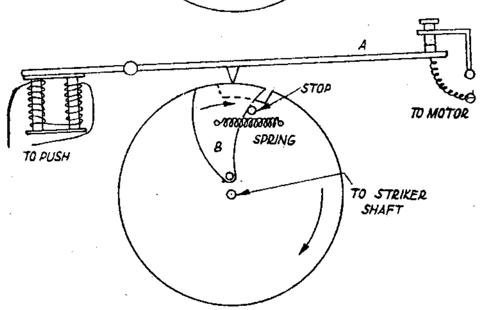
I am pleased to announce that a new society has been formed bearing the title "Newton Abbot and District Model Engineering Society." Already, ways and means have been discussed for raising funds to obtain a permanent headquarters and workshop, and with this in view an exhibition is being planned. Although at present lacking in numbers, this young society has an abundance of enthusiasm, and it is hoped that all those with model engineering interests living in the district will get in touch with the Honorary Secretary of the Society, Mr. D. W. Knell of 98, Pinewood Road, Milber, Newton Abbot, who assures me that a friendly welcome awaits all model engineering enthusiasts.—P.D.

Editor's Correspondence

A Chiming Door Bell

DEAR SIR,—I was interested in the " Chiming Door Bell " by Mr. A. R. Turpin in a recent issue and, having made up a similar bell some years ago, only using eight tubes, and not being able to overcome the over-ride of contacts, due to hot weather, and number of times bell is used





when people first hear it ring, I made the contacts as shown in rough sketch. On bell being pushed, armature is raised, releasing catch "B" making contact for motor for one complete revolution.

Yours faithfully,

London, S.W. H. V. YEATMAN.

New Use for Old Pistons

DEAR SIR,—Out of ordinary gratitude for such a splendid notion on the part of Mr. J. G. Slender, in his article on the above subject, I am offering a development :—Use the gudgeon-pin holes as they are, put up with the curved outside for the shaft flanges to work against (or pin drill it to a flat) ; buy (or steal from the kitchen) a saucepan lid to fit the open top ; hang an old piston ring (small) on the shaft, or a piece of small diameter, put oil into the bottom, and you have a ring-oiled grinder ! When the piston wears, use another ; it will be less trouble than bushing.

Yours faithfully,

Cambridge. A. WINSHIP.

Gear-cutting Data

DEAR SIR,—I wonder if you or one of your readers can help me. I have just purchased a 5 in. IXL lathe and I find that the first gear in the back gear (that is the gear which is attached to the three-cone pulley) is missing. Could you, or a reader with a similar machine, supply me with the data necessary to make this gear, as all efforts to obtain one have proved fruitless.

Yours faithfully,

London, N.W.10. D. BAMPING.

Treadling

DEAR SIR,—May I crave editorial forgiveness for an error in my letter published in the June 10th issue of THE MODEL ENGINEER ? In the third paragraph from the end " at rest " should read " at bottom of stroke," which is a very different position.

Doubtless my error has been noticed, but it's as well to rectify myself. It looked awful in print. The " at rest " position is best fixed at about 45 deg. past t.d.c.,so all one has to do is to tread once and the machine's away, and then, all one has to do is to keep it going. The wheel may be rotated around its shaft so as to bring the point of balance so that treadle is in correct position and then fixed, or suitable balance weights may be fixed to flywheel rim so as to bring the treadle " just right " for starting, which is the main thing. Generally, if a treadle motion starts with minimum effort at first tread, there will be little effort needed to keep it going. Main thing is to get it just right for its particular user. I believe I am correct if I say that some people will never be able to comfortably treadle, they somehow aren't adapted that way. Others again, irrespective of age, are just " naturals."

Yours faithfully,

Penzance. HERBERT J. DYER.

Design of Treadle Gear

DEAR SIR,—Mr. Dyer's letter in the June 10th issue explaining the leverages of Mr. K. N. Harris's old-time treadle gear seems to have missed the point.

It is fairly obvious that by connecting the pedal arm direct to the existing crank, the foot stroke is increased ; however, Mr. Harris was careful to point out that by *shortening* the crank throw to suit, the same result could have been obtained without the added complication and expense of the long vertical arm.

In fact, Mr. Dyer's 5-in. Milnes has the treadle directly connected to the crankshaft, as Mr. Harris advocates ; so the necessity for the long vertical arm is still unexplained.

Yours faithfully,

Berkhamsted. JOHN LATTA.

Broken Taps and Studs

DEAR SIR,—I should like to compliment Mr. J. W. Tomlinson on his article on the above subject which contained some very useful hints; may I draw attention to one or two relevant points enumerated below?

1. Mr. Tomlinson states, that when a stud has been in use for some time, especially at high temperatures, it may become brittle, because it has "crystallised". This is a popular fallacy, which should be dispelled. All metals are simply built up of crystals, which exactly interlock, like a three-dimensional jig-saw puzzle. They owe their very strength and toughness to these crystals, which may be as large as four (4) inches long in pure zinc, or as small as 0.001 in. in steel. Two most common reasons for steel parts breaking or becoming brittle after some service are :—

(*a*) If the component is subject to fluctuating loads (e.g., a crankshaft, valve-spring, gudgeon pin, etc.), a small crack sometimes starts, at a surface imperfection or tool mark, which then acts as a notch, producing its own stress concentration; and "jumps" a step at a time, until after some hours, months, or even years, the section of the component left to carry the load is so small that it fails by overstressing. Or else the cracked component may fail during dismantling. This type of fracture is readily distinguished by the parallel arc-like marks with their centre at the origin of the fracture running out across the section like the waves in a pool when a stone is dropped. The best insurance against this failure in pieces of mechanism subject to fluctuation and/or rapid reversal of stress, is to have a very good surface finish, no sharp corners and ample section to carry the load.

(*b*) Some types of steel, if overloaded, and then left to "age," at room temperature, or, worse still, a higher temperature, become very brittle. The interesting thing is that steel made brittle in this way, is still quite tough when hot, but brittle at temperatures below 100 deg. C. If a stud or other component is not initially overloaded this condition cannot arise, hence the importance of knowing when to stop tightening a nut on a superheater, etc.!

2. The drilling (or, in fact, cutting in any way) of some metals is rendered very difficult because of an effect called "work-hardening." Stainless steel (the non-magnetic stuff, not stainless iron, the metal of which most cutlery is made!) is a case in point, together with 12 per cent. manganese steel (used for dredging and excavating bucket lips, some railway points, and armour plate, etc.), harden up considerably when they are hammered or rubbed in any way. Thus if a heavy centre "pop" is made in such sheet metal, this area may be made so hard that it will either cause the drill to wander away, or even blunt it. Similarly once drilling is commenced, the drill should never be allowed to run idly and burnish the hole, but should be continuously and lightly fed, smartly removed for swarf clearance, and smartly reinserted. This will save much bad temper and many breakages. In shaping and turning such material, too light a cut is often a mistake, a slightly heavier cut enables the tool to bite under the work-hardened surface layer left from the preceding passage of the tool.

3. When a tapping hole has been drilled on a lathe or drilling machine, in the usual way, the centre frequently provided in the head of a tap may be supported by a lathe centre held in the tailstock or spindle nose respectively, and fed into the work exactly co-axial with the drilled hole. If the work is performed on a drilling machine, a ratchet tap wrench will probably be required; but in the lathe the tap wrench can bear on the saddle or tool post, whilst the face-plate is rotated by hand, the tap being advanced by pressure from the tailstock, judiciously applied.

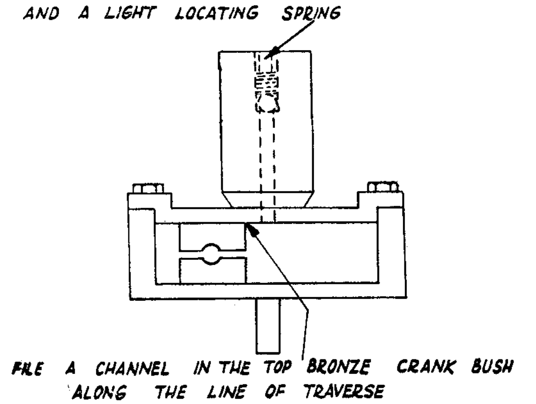
In conclusion, I always find resin a much better lubricant for tapping, than lubricating or cutting oil. It is certainly far less "messy."

Yours faithfully,

Southsea. D. BIRCHON.

R.A.F. Air Compressors

DEAR SIR,—Regarding Mr. Tyler's letter in THE MODEL ENGINEER, dated April 21st, 1948, relating to ex-R.A.F. air compressors, having bought one of these compressors some time ago, I found on examination that there is no inlet-valve into the cylinder other than two slots at the bottom end, the piston permitting the entry of air already compressed in the crankcase into the cylinder by means of these two slots at the end of its downward stroke.



Therefore, the piston on its downward stroke or what would normally be the inlet stroke is producing a vacuum in the cylinder and at the same time compressing the air in the crankcase. The purpose of this being to render the compressor free from vibration without the need of a heavy flywheel.

One will appreciate that the power required to run one of these compressors is far in excess of what would be required under normal conditions. The only alternative to this is to fit an inlet-valve in the piston and to fit a heavy flywheel. This can be done in the following manner. Drill the piston down the centre and fit a ball-valve and a light locating spring. File a channel in the top bronze crank-bush along the line of traverse so that at no point of the stroke is the air-inlet hole that we have drilled in the piston sealed by the crank-bush. Yours faithfully,

Banbury. F. SHEPLEY.